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ARCHIVES OF OTOLARYNGOLOGY

VOLUME 19 MARCH, 1934 NUMBER 3

CEREBRAL (VENTRICULAR) HYDRODYNAMIC TEST FOR THROMBOSIS OF THE LATERAL SINUS

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BALTIMORE

That thrombosis of the lateral or sigmoid sinuses, or the sequelae, may at times be responsible for the clinical signs and symptoms that suggest an intracranial tumor or abscess, especially the latter, is well recognized. When the character or position of the presumed intracranial lesion is not known, it is usually necessary to employ ventriculography in order to clarify both the diagnosis and the localization of the lesion. In practically all of these doubtful cases bilateral papilledema is the outstanding objective finding. Although papilledema is by no means a positive proof, it is a strong presumptive evidence of intracranial pressure.

It is of course possible, with recognized exceptions, to determine by a lumbar puncture whether or not the papilledema is due to increased intracranial pressure. But neurosurgeons have learned by unfortunate experiences that lumbar puncture is fraught with far too much danger to life and function to be used for this purpose. When a tumor or abscess is suspected, the only safe method of obtaining the necessary information is by ventricular puncture, which, in addition to the determination of the presence or absence of intracranial pressure, also permits —by the introduction of air (ventriculography)—the precise localization of the lesion, if one exists, or the elimination of this diagnosis if no lesion is present.

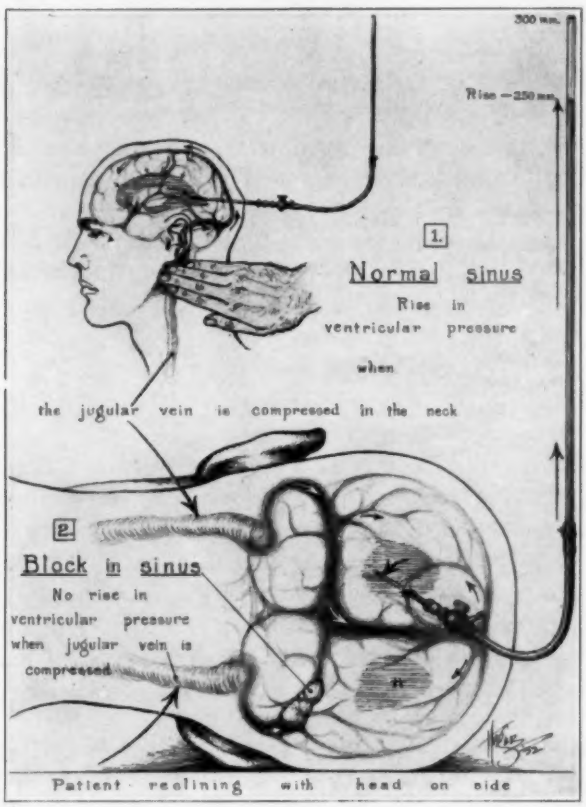
Heretofore in order to make a positive diagnosis of thrombosis of the lateral or sigmoid sinuses after negative results from ventricular puncture (with or without ventriculography) it has been necessary to perform lumbar puncture with the Queckenstedt test at a later time. This test (first applied by Tobey and Ayer), though open to error, is an important advance in the recognition of thrombosis or at least of occlusion of these sinuses.

It recently occurred to me to wonder why precisely the same results could not be obtained by ventricular puncture. The hydrodynamic principles are exactly the same. Compressing one or both jugular veins causes venous congestion in the cerebral veins, and this in turn causes a rise of intracranial pressure which should register by a ventricular manometer equally and not less accurately than by the lumbar route. Occlusion or patency of a lateral sinus should, therefore, be disclosed as

readily as by the Tobey-Ayer test. In the following five cases the ventricular test was checked with the Tobey-Ayer test in three instances and by necropsy in the remaining two.

REPORT OF CASES

CASE 1.—C. C., a well nourished woman, aged 40, was drowsy and unresponsive though not comatose; she complained of right-sided headaches. The illness began


300 mm.
Rise — 250 mm.
1.
Normal sinus
Rise in ventricular pressure when the jugular vein is compressed in the neck
2.
Block in sinus
No rise in ventricular pressure when jugular vein is compressed
Patient reclining with head on side

Underlying mechanical principles of the cerebral test for thrombosis of the lateral or sigmoid sinuses.

four weeks before admission with earache on the right side; a thin yellow discharge appeared two days later. Two weeks later she was nauseated, but did not vomit. There were many hot and chilly sensations during this time and a dull, throbbing, temporal and occipital headache on the right. Shortly afterward the vision declined in the right eye, and the right eyelid drooped. She had since been bedfast and unresponsive. The discharge from the ear remained practically unchanged.

Examination.—The face was flushed; the lips were dry and cracked, and the skin moist and hot. The temperature was 102 F., the pulse rate, 120. During

the night the temperature and pulse remained unchanged. The respiratory rate was 20; the blood pressure, 180 systolic and 110 diastolic. The leukocyte count was 15,000, with 80 per cent polymorphonuclears.

The neurologic examination showed papilledema of 4 diopters in both eyegrounds and punctate hemorrhages alongside the disks. The visual acuity in the right eye was much reduced; on rough test there was no hemianopia. The right pupil was smaller than the left. There was a definite paralysis of the abducens muscle on each side. Although there was ptosis of the right eyelid, the extraocular muscles supplied by the third nerve were not affected. A slight facial weakness of the peripheral type was evident on the right side. The hearing was markedly diminished in the right ear. On the left side there was a positive Babinski sign, and the corresponding knee jerk was increased. The Kernig sign was positive on both sides, and there was marked rigidity of the neck.

Diagnosis.—There were four possibilities: (1) abscess or abscesses of the brain, (2) meningitis, (3) thrombosis of the sinus and (4) encephalitis.

Ventriculography and Subsequent Course.—Ventriculography (by ventricular puncture) was necessary for the differential diagnosis and for determination of the line of treatment. On Jan. 9, 1932, the ventricular fluid was under no increased pressure; venrticulograms were normal; the ventricular fluid contained only 10 cells, 3 of which were of the polymorphonuclear type. It was therefore clear that the patient had neither meningitis nor an abscess of the brain. At once a Queckenstedt test was made by means of the spinal puncture, and it was found that jugular compression produced no rise of the fluid on the right side. However, a prompt and rapid rise resulted when the left jugular vein was compressed, and when compression of the vein was withdrawn the fluid fell rapidly to its previous level. It was clear, therefore, that the patient had thrombosis of the right lateral or sigmoid sinus. The numerous neurologic findings were, of course, not directly due to the thrombosis of the sinus, but doubtless to systemic invasion by the infection of the mastoid and perhaps of the lateral sinus.

The patient was later treated by Dr. Crowe who opened the mastoid and found a thrombosis of the lateral and sigmoid sinuses; he ligated the jugular vein in the neck. She has since remained well.

The hemolytic streptococcus was isolated from the ear and also from the lateral sinus, which was opened and cleared of its contents. The same organism grew from the blood that was taken when she was admitted to the hospital.

Ventricular Test for Thrombosis of the Lateral or Sigmoid Sinus: During her stay in the hospital it occurred to me to wonder why it might not have been possible to make a positive diagnosis of thrombosis of the lateral sinus at the time the ventricular puncture was first done. The patient would then have been spared the additional lumbar puncture for the Tobey-Ayer test.

A ventricular puncture was again made on Jan. 27, 1932. The initial height of the fluid was 19 cm. Pressure on the left jugular vein caused the fluid to rise to 33 cm., and it descended promptly when the pressure was released. Pressure on the right jugular vein produced no change in the height of the ventricular fluid at any time.

The results of the ventricular test were, therefore, identical with those of the spinal test.

Case 2.—M. C., aged 35, was referred by Dr. Ralph Greene of Jacksonville, Fla., on May 7, 1932, with the probable diagnosis of an abscess of the brain.

Illness dated back to Dec. 30, 1930 (eighteen months before), when bilateral otitis media developed during a severe cold; both drums were lanced and drained

for about ten days. A few weeks later an abscess of the right upper lid was opened, and shortly thereafter furuncles developed in both external auditory canals. In January, 1931, an operation on the left mastoid was followed by chills, a temperature of 105 F. and erysipelas of the face. In three weeks recovery was complete. In October, 1931, a boil developed in the right nostril, and during the following month one on the right arm. The patient was soon well again. In February, 1932, three months before admission to the Johns Hopkins Hospital, bilateral otitis media again developed, and again both drums were incised and drained about ten days. At this time the patient had a chill, a temperature of 104 F. and pains in the left side of the chest; it was said that she had some pulmonary congestion but not pneumonia; three days later this pain had disappeared. For over a month a rise in temperature of a few degrees persisted; both mastoids were again opened on March 4, 1932. The low fever continued, and two weeks later chills and high fever (from 104 to 105 F.) again developed. Altogether there were about twenty chills; these sometimes appeared on two consecutive days; at other times they were three or four days apart.

On April 3, 1932, the right mastoid was again opened and an epidural abscess evacuated. For the next month the patient continued to have right-sided headaches, which were most pronounced above the mastoid; these were of a dull character and radiated to the frontal region. Shortly afterward the same headaches developed on the left side. One week before admission there was a severe sharp pain in the left occipital region and at the same time a whistling noise in the right ear. In the last five days this had become a dull, steady roar. The patient had frequent attacks of vomiting. One month previously she complained of numbness in both legs from the ankles to the knees, but there were no objective changes. She had not had a chill for over a week before admission to the Johns Hopkins Hospital, although her temperature reached 101 F. nearly every day. There had been a pain below the left shoulder blade for the past week. About a week before admission a lumbar puncture was made by Dr. Greene, at which time greatly increased intracranial pressure was said to have been found. She had lost 31 pounds (14.06 Kg.) during the past three months.

Examination.—The patient was a normal appearing young woman, slightly fatigued. There was some evidence of loss of weight, but her general condition was good. The temperature was 100 F.; the pulse rate, 110, and the respiratory rate, 120; the blood pressure was 124 systolic and 78 diastolic. There was some tenderness along both mastoid wounds, which were not entirely closed, there being a small area of granulation tissue in both retracted scars.

The neurologic examination gave negative results except for a low grade of papilledema, which was perhaps more marked in the right eye.

Impression.—Although a cerebral abscess was considered because of the low grade papilledema, headache, vomiting and Dr. Greene's report of increased intracranial pressure, it was doubtful that an abscess explained the condition, particularly in view of the long continued fever and chills, neither of which should have been present had an abscess of the brain existed at the beginning of the trouble over two months before.

Roentgen Examination.—Roentgenograms of the mastoid region were taken, and on the right side there appeared to be evidence of occlusion of the lateral sinus in that the curve of the lateral sinus tapered to a point midway between the torcular herophili and the mastoid. This was thought to be evidence of thrombosis of the lateral sinus, but I was entirely unfamiliar with such a positive finding.

Ventriculography and Subsequent Course.—Ventriculography was needed for differential diagnosis. There was no increased intracranial pressure. The fluid barely rolled out of the needle and attained a height of only 10 cc.

Pressure on the left jugular vein produced a rapid rise to 35 cm.; on release the fluid returned to the original level. Compression of the right jugular vein produced no rise whatever in the column of ventricular fluid. Pressure on both jugular veins produced exactly the same rise that obtained when the left jugular vein alone was compressed. Thrombosis of the right lateral sinus was therefore evident.

The ventriculograms were normal, thereby excluding a cerebral abscess; moreover, the fluid contained only 8 cells.

Operation on the mastoid was later performed by Dr. Henry R. Slack, Jr., who found infected granulation tissue extending into the attic; there was no free pus. The lateral sinus was not opened. Following the operation signs of meningitis developed from which the patient died.

Autopsy.—In addition to meningitis the autopsy showed an old healed thrombosis of the right lateral sinus. There were no cerebral abscesses. A small pocket of pus occupied a badly eroded anterior tip of the petrous portion of the right temporal bone, and was responsible for the chills, fever and other symptoms of recent months.

CASE 3.—D. B., a well nourished girl, aged 11 years, was referred with the diagnosis of a probable tumor of the brain.

She complained of headache and vomiting. The patient had been perfectly well until the advent of severe frontal headaches six weeks before admission. These were aggravated by exercise and helped by rest. Spells of vomiting were frequent and relieved the headaches. At times there was vertigo. The mother thought that an infection in the paranasal sinus preceded the onset of the trouble, but of this she was not certain. The patient believed that she had been improving in the past week.

The physical and neurologic examinations gave entirely negative results, except for papilledema of moderate degree (2 diopters) in both disks; the retinal veins were full. There was an old retinal hemorrhage on the left. The temperature was 100 F.; the pulse rate, 100, and the white cell count, 10,500.

Impression.—The patient probably had a tumor, or possibly an abscess without signs of localization.

Ventriculography; Queckenstedt Test.—Ventriculography was necessary for the differential diagnosis; it showed that fluid from the right ventricle reached a height of 140 mm. of water. On compression of either the right or the left jugular vein alone there was no rise. On compression of both jugular veins together the fluid immediately ascended to 300 mm. Fifteen cubic centimeters of air was injected into the right ventricle. The ventricular system was entirely normal, thereby excluding the possibility of both a tumor and an abscess. The ventricular fluid showed only 2 cells.

Three days later a spinal puncture was performed in order to inject phenolsulphonphthalein to test absorption. A Queckenstedt test was made at this time and gave precisely the same results as those obtained with the ventricular puncture.

Diagnosis.—The papilledema was due to an unknown cause but not to a tumor or cerebral abscess. There was no thrombosis of the lateral sinus.

CASE 4.—R. C., a well nourished young man, aged 21, was referred with the diagnosis of a tumor of the brain. He complained of headache and paralysis. The family and past histories were negative. The present illness began four months before admission with a complaint of mild headaches without localization and

occasional vomiting. For the past two months he had vomited several times a week; recently the vomiting had been projectile. A gradually progressive hemiplegia on the left and diplopia had begun two months previously. Recently the right side of the face had felt "dead." Clonic movements of the left arm and leg had recently appeared, without convulsions or loss of consciousness.

Physical and Neurologic Examinations.—The patient was bedfast but in good general condition. There were optic atrophy in the right disk and a mild grade of papilledema with loss of visual acuity in both eyes; the vision of the left eye was 4/20; that of the right, 4/70. Paralysis of the right abducens muscle, absence of the right corneal reflex, hypo-esthesia on the right side of the face, spastic paralysis of the left arm and leg and loss of sensation; hyperactive reflexes on the left side, absence of the abdominal reflex on the left, a positive Babinski sign on the left, ankle clonus on the left and a 50 per cent reduction in hearing in the right ear were also noted.

Provisional Diagnosis.—Tumor of the brain, probably in the brain stem, but possibly in the right cerebral hemisphere, was considered.

Trephination and Injection of Air; Cerebral and Spinal Queckenstedt Test.—The right ventricle was tapped; the fluid registered 160 mm. of water. On compression of either the right or the left jugular vein the level of the fluid remained unchanged, but following compression of both jugular veins the fluid slowly rose to 330 mm. Additional pressure in the region of the occiput produced a further rise to 480 mm. This finding was repeated several times with similar results. Air was injected, and the lateral ventricles were found to be normal.

In order to check the interesting findings of the cerebral Queckenstedt test a spinal puncture was performed; the results were exactly the same.

Final Diagnosis and Subsequent Course.—The diagnosis was that of an infiltrating tumor of the brain stem, an inoperable lesion.

The patient's signs and symptoms steadily progressed. At necropsy, three weeks later, the clinical diagnosis was substantiated. The occipital sinus was larger than either lateral sinus. It emptied into the jugular bulb on the left side.

CONCLUSIONS

A ventricular hydrodynamic test is proposed by which the diagnosis of thrombosis of the lateral sinus can be made or excluded with the same degree of accuracy as that obtained with the spinal Tobey-Ayer test.

Unilateral jugular compression (each side is tested separately) will cause the pressure of ventricular fluid to rise (with exceptions) if the lateral sinus is patent, and the level of the fluid will promptly fall when the venous compression is released. If a rise of the ventricular pressure does not follow jugular compression on one side but follows compression on the other, the lateral sinus is probably occluded or absent on the former side.

The use of this procedure instead of the spinal test is suggested only when a ventricular puncture is required to diagnose or eliminate the possibility of a tumor or an abscess of the brain by ventriculography. Under such circumstances it merely makes an additional spinal puncture unnecessary.

SENSORY DISTURBANCES FOLLOWING RADICAL OPERATIONS ON THE ANTRUMS

WITH AN EVALUATION OF THE VERTICAL INCISION

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AND

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It is a matter of common experience that operations on the maxillary sinus of the Caldwell-Luc or the Denker type are followed at times by anesthesia, hypesthesia or paresthesia of the cheek, upper lip or teeth on the same side. The literature on the subject is not extensive, most investigators having been concerned with ascertaining the extent of the damage to the teeth rather than with the subjective symptoms just mentioned—symptoms which are not accompanied necessarily by demonstrable evidence of injury to the nerve. Our own study was prompted, in part at least, by a recent contribution of Menzel [1] on this type of complication. On the basis of some anatomic studies, the author reached the conclusion that certain of these postoperative sensory disturbances, notably those involving diminution of sensation, are due to the complete severance of the branches of the infra-orbital nerve as a result of the usual horizontal incision of the mucous membrane in the canine fossa, and recommended instead a vertical incision which is designed to leave most of the branches intact. Because of the interest attached to Menzel's proposal, as well as the general importance of the subject in view of the current popularity of the radical operation on the antrum, we decided to conduct our investigation with a twofold aim: first, to record and study all evidence of sensory disturbance following a group of consecutive radical operations on the antrums of patients in the clinic, and second, to compare the vertical incision recommended by Menzel with the usual horizontal incision with the view of preventing some of the sequelae.

From the Department of Laryngology, Rhinology and Otology, College of Medicine, University of Illinois, and the College of Dentistry, University of Illinois.

1. Menzel, K. M.: Zur Technik der Radikaloperation der chronischen Kieferhöhleneiterung. Eine Modifikation des Schleimhautschnittes, Monatschr. f. Ohrenh. **64**:318, 1930.

METHOD

Seventeen patients were subjected to radical operations on both antrums, all of the Caldwell-Luc type. The indication in each instance was either long-standing suppurative or hyperplastic infection of the sinus requiring surgical intervention of this type. On the right side, the usual horizontal incision was made and on the left side, the vertical incision, starting above the first premolar tooth and running somewhat medially according to the instructions of Menzel. One operator (S. L. S.) always worked on the left side and the other (N. D. F.) on the right side. The technic employed, aside from the incisions in the mucous membrane, was the one ordinarily followed in this clinic. Local anesthesia and preoperative medication with morphine were used as follows:

Applications of cocaine (10 per cent) were made by means of packs under the lips and the inferior turbinates, as well as applicators in the region of the spheno-

Fig. 1.—Operative field, showing the Allport mastoid retractor in use.

palatine ganglion. Subperiosteal injections of 2 per cent procaine hydrochloride were also used to anesthetize the branches of the infra-orbital and the posterior superior alveolar nerves. After the antrum was entered, a gauze pack of a 10 per cent solution of cocaine was placed in the sinus and allowed to remain for ten minutes.

Following the incision in the canine fossa, the periosteum was elevated and an opening made into the antrum by means of a gouge or an electric burr. At the conclusion of the first case, we found that when the vertical incision was employed, an Allport mastoid retractor the ends of which had been bent to fit the concavity of an average canine fossa (fig. 1) furnished an admirable exposure, and consequently this instrument was used in the remaining sixteen cases. The mucous membrane of the antrum was removed completely in each instance. This was effected by means of elevators, gauze sponges and forceps; curettage was seldom

done, and care was also taken not to lower the inferior margin of the bony opening excessively, for fear of injuring the teeth. A large window into the inferior meatus and closure of the incision without packing the sinus completed the operation.

RESULTS

Our observations regarding the merits of the two types of incisions in the mucous membrane may be summarized thus:

Postoperative Results in Ten Patients

Name	Complaints	Pin Test	Faradic Current	Heat	Cold	Comment
Mr. E. W.	When he comes in out of the cold the teeth and gums on the left side ache	Normal	+	+	+	
Mr. O. M.	Ever since the operation his left cheek has been sore and numb	Small area of anesthesia on under side of right lip	+	+	+	
Mr. H. D.	No complaints	Slight dulling of sensation on both sides along area of incisions	+	+	+	
Mrs. B. M.	Both sides still sensitive, more on the left	Normal	+	+	+	
Miss M. L.	Numbness on left side	Normal	+	+	+	
Miss V. C.	Some numbness over teeth on left side	Normal	Left cuspid, right cuspid and first and second bicuspids do not respond to faradic current; right second bicuspid also insensitive to heat and cold			Roentgenogram of right second bicuspid shows no signs of disease
Mrs. K. W.	Left side painful; numb feeling on both sides	Normal	Upper jaw edentulous			
Mrs. M. R.	Numbness of left upper lip; entire left side faintly numb at times	Normal	Upper jaw edentulous			Adhesion on left side
Mrs. R. S.	No complaints	Normal	Upper jaw edentulous			Adhesions in region of left bicuspid
Mrs. R. L.	Left side much more numb than right; sensation gradually returning	Greater response to pin pricks on right side in canine fossa; cheeks show normal sensation	Upper jaw edentulous			

The vertical incision possesses some advantages from the standpoint of exposure, as a simple self-retaining retractor can be inserted in the wound.

Bleeding was observed to be somewhat less when the vertical incision was used (as claimed by Menzel).

In one case there was a fistula on the side of the vertical incison, but this closed in about ten days.

No anesthesia of the cheek or very marked swelling was noted following any of the thirty-four operations. Nearly all of the patients

had some complaints of tenderness and paresthesia within the first four weeks after their operations; no appreciable difference between the two sides was detected in this respect.

One year after operation ten patients returned for a check-up of their complaints. Four had had their upper teeth removed in the intervening period; the others were referred to the dental department for studies of the condition of those teeth which might have been affected by the operation. Electrical, heat and cold tests were used. The electrical test consisted of passing a suitably graded amount of faradic current from an electrode applied to the enamel of the tooth, through the tooth and body to a hand electrode. Just enough current was used to produce a response from the vital pulp, but not enough to produce a response from a tooth with a dead pulp. The heat test consisted of applying heated gutta-percha to the crown of a tooth for a second or more; a sharp painful response of a second's duration indicates a normal, vital pulp. The cold test was made by applying ice to the crown of the tooth.

The combined results of both dental and otolaryngologic departments are interpreted in the accompanying table.

It will be seen from the table that of the ten patients with bilateral Caldwell-Luc operations eight made complaints relative to sensation, but that only two of these patients showed even slight changes when tested with a pin; the left side was stated to be the seat of the trouble or the worst area in all instances. Of the six people who had dental tests, only one showed any abnormalities, and only one of her teeth was completely insensitive.

FACTORS UNDERLYING SENSORY DISTURBANCES AFTER RADICAL OPERATIONS ON THE ANTRUMS

Innervation of the Operative Field.—The maxillary nerve on leaving the infratemporal fossa enters the infra-orbital canal where it receives the name of the infra-orbital nerve. The infra-orbital canal traverses the roof of the maxillary sinus. At the end of the canal the nerve makes its exit through the infra-orbital foramen breaking up at once into numerous branches under cover of the quadratus labii superioris and in front of the musculus caninus. These anastomose in part with zygomatic branches of the facial nerve to form the infra-orbital plexus, and, according to Testut and Jacob,[2] with the buccal branch to form a buccal plexus also; from separate branches of the infra-orbital nerve as well as from these plexuses arise nerves to the lower eyelid, the surface and deeper structures of the cheek, the alae of the nose and

2. Testut and Jacob: Anatomie topographique, Paris, Gaston Doin, 1921, p. 246.

the upper lip. The teeth, gums and mucous membrane of the maxillary sinus are supplied by the superior alveolar nerves which are as follows (fig. 2):

The posterior superior alveolar nerve originates in the infratemporal fossa and almost immediately divides into two branches which proceed downward on the posterior aspect of the body of the maxilla. They contribute a few fine filaments to the mucous membrane of the cheek and to the gum and then disappear into the minute posterior alveolar foramina to supply the three upper molar teeth and the lining membrane of the maxillary sinus.

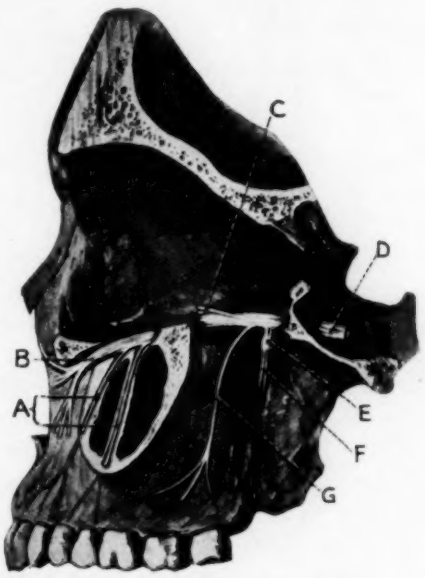

Fig. 2.—Distribution of the superior alveolar nerves: *A*, the middle and anterior alveolar branches; *B*, the infra-orbital nerve appearing on the face of the infra-orbital foramen; *C*, zygomatic nerve at the inferior orbital fissure; *D*, maxillary nerve at the foramen rotundum; *E*, sphenopalatine ganglion and nerves; *F*, palatine branches, and *G*, posterior superior alveolar nerve. (From Cunningham's Textbook on Anatomy, New York, Oxford University Press, 1931, p. 693.)

The middle superior alveolar nerve supplies the two premolar teeth. It arises from the infra-orbital nerve at the back of the infra-orbital foramen and descends in a minute canal which traverses the lateral wall of the maxillary sinus.

The anterior superior alveolar nerve, much the largest of the three alveolar branches, springs from the infra-orbital nerve as it approaches the anterior part of the canal. It enters a special bony tunnel which traverses the maxilla in the anterior wall of the sinus. After supplying

a branch to the mucous membrane of the lower and anterior part of the nasal cavity, the anterior superior alveolar nerve divides into branches for the incisor and the canine teeth.

While traversing the maxilla, the three superior alveolar branches communicate with one another and form two nerve loops. Numerous twigs proceed from both loops, uniting to form a fine plexus. It is from this plexus that the terminal filaments to the teeth and gums take origin.

From the short description just given as well as from the general anatomy of the antrum, which needs no description here, the following possibilities for sensory disturbances as a result of operations on the sinus come under consideration:

1. Damage to the trunk of the infra-orbital nerve at its point of exit from the foramen. Rough handling in this location may injure it beyond repair, with resulting permanent anesthesia of the cheek. Such a complication is quite infrequent, but Hajek [3] mentioned a case which he considered due to this type of injury.

2. Damage to the branches of the infra-orbital nerve as a result of the usual transverse incision. This factor was considered by Menzel to be responsible for anesthesias of the cheek, and it was with the idea of preventing the section of most of these branches that he proposed the vertical incision. Our personal experiences as well as our anatomic study [4] of the innervation of the region involved make us doubt whether anesthesia of the cheek is really the result of the usual horizontal incision. Such a section, of course, would cut those twigs which supply the mucous membrane resting on the anterior surface of the superior maxilla, but anatomists as well as our own dissection indicate that those branches of the infra-orbital nerve which supply the cheek arise above the reflection of the mucous membrane of the canine fossa on the inner surface of the upper lip, i. e., well above the level of the usual incision for the radical operation on the antrum. This fact doubtless explains the rarity of demonstrable anesthesia of the cheek following operations on the antrum.

In order to ascertain what symptoms, if any, may be produced as a result of incision and stripping of the mucous membrane of the canine fossa, two additional patients (besides those previously mentioned) were subjected to the incisions alone, a vertical one on the right side and a horizontal one on the left, with elevation of the periosteum; no further

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3. Hajek, M.: Pathologie und Therapie der entzündlichen Erkrankungen der Nebenhöhlen der Nase, Vienna, Franz Deuticke, 1915, p. 158.

4. Made possible through the courtesy of Dr. Kampmeier, head of the Department of Anatomy.

steps were made, the incisions being closed by sutures. It was noted that after the first few days no complaints relative to any sensory disturbances were made.

3. Damage to the superior alveolar nerves. It is our opinion (fig. 2) that this is unavoidable, with respect to the anterior alveolar nerve, if an opening sufficient to accomplish the purpose of the operation, namely, the complete inspection and removal of the diseased mucous membrane, is to be made. The posterior and, in most instances, the middle alveolar nerves should escape injury.

4. Damage to the fine branches of the three alveolar nerves within the antrum. It is difficult to see how these branches, especially the dental plexus beneath the mucous membrane supplying the periodontal membrane of the teeth, can escape injury when the mucosa of the antrum is completely removed; damage to the trunk of the inferior alveolar nerve while stripping the mucous membrane of the roof of the sinus is also a possibility.

5. Functional causes. It is difficult to disprove this factor as a basis for some of the complaints noted, particularly when these are not, as is generally the case, accompanied by demonstrable alterations of sensation to pinprick or other means of testing. For various reasons, some of which already have been stated, we do not believe that any considerable percentage of the discomfort recorded by our patients is on this basis. It is only necessary to bear in mind the peculiar and similar character of most of the complaints following radical operation on the antrum as well as their relative infrequency following other procedures on the sinuses to grasp their essential organic basis.

Nature and Extent of the Damage to the Teeth Resulting from Radical Operations on the Antrums.—This interesting topic has been discussed by a number of men. The earlier writers,[5] using only the faradic current, found a large percentage of the teeth examined to be insensitive and came to the conclusion that these teeth were dead and would sooner or later have to be removed; later investigators, however, using more extensive methods of examination, took a much less serious view of the matter. Holzmann,[6] for instance, on the basis of roentgen studies of teeth which were insensitive to all forms of stimulation, concluded that even in this case the death of the pulp was unlikely. As far as our small series of cases is concerned, only one patient showed complete dental insensitivity. Roentgen examination of the involved teeth showed no changes, thus apparently supporting Holzmann's contention.

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5. Amersbach, K.: Zur Frage der Radikal-Operation der Kieferhöhle, Ztschr. f. Hals-, Nasen- u. Ohrenh. **15**:485, 1926.

6. Holzmann, W.: Einfluss der radikalen Kieferhöhlenoperation (nach Caldwell-Luc) auf das Zahnsystem, Deutsche Monatschr. f. Zahnheilk. **22**:1089, 1931.

In evaluating the results of our dental tests, it must be borne in mind that these are designed to ascertain the response of the pulp. The periodontal membrane cannot be tested in this manner and, as a matter of fact, is difficult to test at all. This raises the question as to whether injury to the innervation of this membrane in the course of radical operations on the antrums may not be the explanation behind the complaints of anesthesia and hypesthesia about the teeth in the presence of negative objective tests.

SUMMARY

1. Seventeen patients were subjected to bilateral Caldwell-Luc operations, the vertical incision being made on one side and the usual horizontal one on the other. Ten of these patients returned one year later for a check-up as to sensory abnormalities. The examinations were conducted by the otolaryngologic and dental departments.

2. No appreciable advantage in favor of the vertical incision was discovered from the standpoint of avoiding disturbances of sensation which may follow the radical operation on the antrum; some technical advantages in the performance of the operation may be obtained through the use of this incision.

3. The course of the alveolar nerves, particularly the anterior alveolar, is such that damage to one or more of them is practically unavoidable in performing the usual type of radical operation on the antrums; this is a logical factor in some of the anesthesias, paresthesias and hypesthesias complained of by patients.

4. There is no evidence that disturbances of sensation in the teeth are accompanied by actual changes in the pulp.

PLASMACYTOMA OF THE NOSE AND NASOPHARYNX

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Plasmacytomas of the nose and nasopharynx are not frequently encountered. Ewing [1] said that considering the comparative frequency and peculiar clinical course of plasma cell tumors of the mucous membranes and lymph nodes, they have received inadequate attention. The literature does not contain many reports of cases of plasmacytoma of the nasal mucosa or nasopharynx. Claiborn and Ferris,[2] in 1931, found only twelve cases in a review of the literature, to which they added two cases of their own. In the last few years, reports of several more cases have been added. Geschickter and Copeland,[3] in a review of the literature on multiple myeloma, reported rare metastases to the tonsil, but none to the nose and nasopharynx.

My purpose in this paper is to report two cases of plasmacytoma that have occurred recently in the routine pathologic work at the Massachusetts Eye and Ear Infirmary; one was a proved case of multiple myeloma, and the other was without demonstrable skeletal involvement. These cases are presented in the hope that they will add something to the knowledge of this rare type of tumor.

REPORT OF CASES

CASE 1.—Mrs. B., aged 70, entered the Massachusetts Eye and Ear Infirmary on Sept. 25, 1933, with a complaint of nasal obstruction. For the past two years, she had had increasing difficulty in breathing through her nose; at the time of admission she could breathe very little through the right side and not at all through the left. She had no pain, bleeding or nasal discharge, but she had had some postnasal dripping. She had lost from 4 to 5 pounds (1.8 to 2.3 Kg.) in the last two or three years. The past history and inquiry as to functional impairment revealed nothing essentially important. On examination of the nose, a large polyp was seen under the right inferior turbinate, which was hard, with a bleeding surface in front; the left naris was clear. The septum deviated to the left. Posterior rhinoscopy revealed a large mass in the nasopharynx, more to the left, which was soft and translucent. The teeth had all been extracted. The tonsils were moderately injected. Examination of the larynx and ears gave negative results, as did the general physical examination. The blood pressure was

1. Ewing, J.: Neoplastic Diseases, ed. 3, Philadelphia, W. B. Saunders Company, 1928, p. 420.

2. Claiborn, L. N., and Ferris, H. W.: Plasma Cell Tumors of the Nasal and Nasopharyngeal Mucosa, Arch. Surg. **23**:477 (Sept.) 1931.

3. Geschickter, C. F., and Copeland, M. M.: Multiple Myeloma, Arch. Surg. **16**:807 (April) 1928.

192 systolic and 92 diastolic. Laboratory examination showed: hemoglobin, 85 per cent; white blood cells, 5,500; polymorphonuclears, 56; lymphocytes, 37, and monocytes, 7. There was no sugar or albumin in the urine. The Bence-Jones test and the Hinton test of the blood were negative.

A biopsy specimen was removed under local anesthesia. The polypoid mass presenting in the right anterior naris was found to be attached to the floor of the nose near the septum. This attachment was incised with scissors and about ½ inch (1.3 cm.) of the tumor removed with a snare. The growth was extremely friable, bled easily and appeared to be very cellular. The mass in the nasopharynx seemed to be attached to the septum on the left side in the region of the vomer; this was not removed.

Roentgen examination of the skull, vertebrae, pelvis, sternum, ribs and long bones of the extremities revealed no evidence of myeloma.

The patient was given a high voltage roentgen treatment and was discharged to the outpatient department to have the roentgen therapy continued. An unsuccessful attempt was made to follow her after the treatment was completed.

CASE 2.—Mr. A., aged 39, was admitted to the Massachusetts General Hospital with a complaint of headache, nausea and vomiting. Fourteen months previously he had noticed paralysis of the right side of the face. He consulted a neurologist, who made a diagnosis of tumor of the brain. Roentgen treatment was advised and given; the patient improved and returned to work. In February, 1933, the headaches recurred, and the patient had six or seven attacks of unconsciousness. He had a similar attack in May, 1933, but none after that time. In May, he began to have severe frontal headaches and some diplopia, and vomited a few times. The headaches progressed, and during the month prior to death, they were accompanied by nausea and nonprojectile vomiting. He also spit up clots of blood, which he thought came from the back of his throat. He lost 10 pounds (4.5 Kg.) during this period. Routine examination, except for the neurologic signs, revealed nothing but a firm, round nodule, 5 cm. in diameter, under the skin to the left of the midline, in the region of the second rib. The physicians in the neurologic service, on the basis of twenty-one positive signs and symptoms, made a diagnosis of a tumor of the lower third of the pons, involving both sides, but more marked on the left. The laboratory tests showed moderate secondary anemia, and a normal white blood count and differential count. The urine contained a large amount of Bence-Jones protein.

Consultation with a laryngologist was requested because of the bleeding from the throat. A small granular mass was seen just lateral to the right eustachian orifice; this bled easily on pressure. A biopsy specimen was taken under local anesthesia. The following day a specimen was taken from the mass over the sternum. The patient's condition grew progressively worse, and one week later, he died.

The significant observations at autopsy included multiple myeloma of the sternum, skull and liver, and bilateral lobar pneumonia. The vertebrae and ribs were normal. The tumor of the skull included a mass in the parietal bone that did not seem to invade the dura, and a growth in the region of the right cavernous sinus which protruded through the dura. There was no evidence of invasion of the brain substance. The sphenoid bone contained some of the tumor growth; the nasopharyngeal region appeared to be normal, except that there was evidence that a biopsy specimen had been removed previously. A section from this region did not reveal any myeloma; the entire tumor was probably removed at biopsy.

While the tumor in the nasopharynx may have been an extension from the skull, it was probably metastatic, as the section in that region taken at autopsy showed no evidence of myeloma.

HISTOPATHOLOGY

Plasmacytoma is a tumor composed of cells of the plasma type. The origin of these cells is not certain. The most widely accepted theory is that plasma cells are derivatives of the small lymphocyte; another is that they are derived from the fibroblasts of the adventitia of the blood vessels. Mallory [4] expressed the belief that lymphocytes undergo a change in the tissues and appear in a form to which the term plasma cell is applied. This cell is usually somewhat larger than a lymphocyte, with

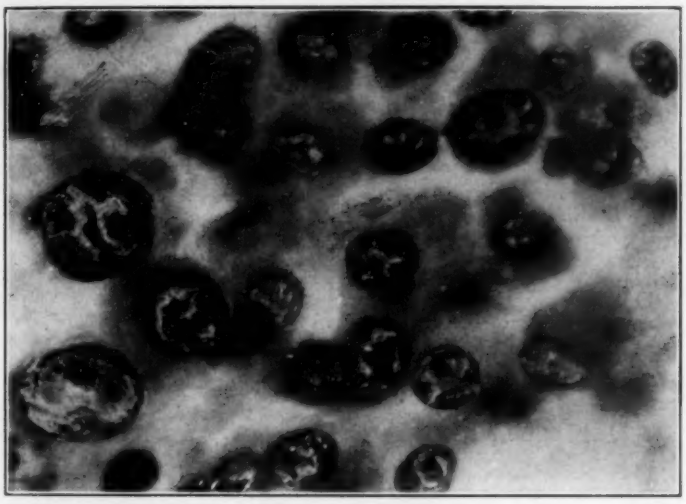

Fig. 1.—Retouched oil immersion photomicrograph showing the variation in the cells composing plasmacytoma. The cells and nuclei vary in size. The nuclei are usually single, but may occasionally be multiple, and are most often eccentric. The chromatin appears in particles and is usually arranged around the periphery of the nucleus, giving the clock-face appearance.

a cytoplasm that is basophilic; that is, it takes an alkaline stain. The nucleus, which is usually single, but may occasionally be multiple, is small and eccentrically placed. The nuclear membrane is definite. The chromatin stains deeply; it is usually arranged about the periphery of the nucleus, giving the so-called cart wheel or clock-face appearance to the cell (fig. 1).

In case 1, the biopsy specimen from the nose showed a tumor, made up of closely packed cells, with a basophilic cytoplasm and an eccentric

4. Mallory, F. J.: Pathologic Histology, Philadelphia, W. B. Saunders Company, 1925, p. 39.

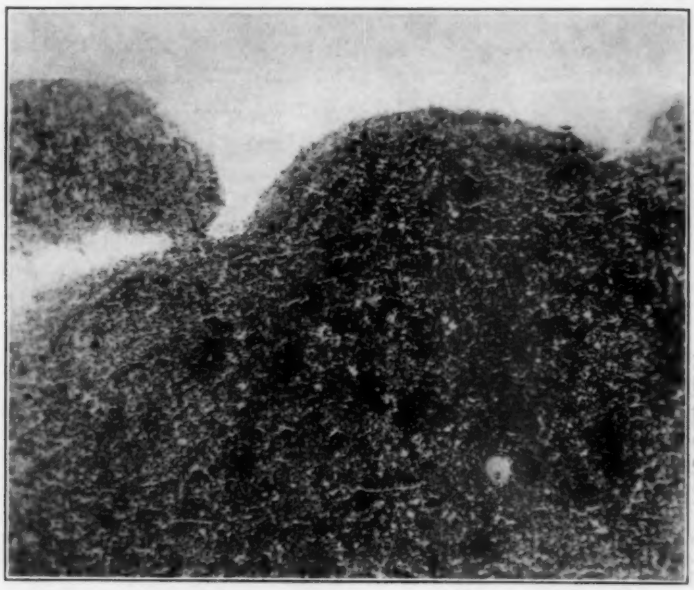

Fig. 2.—Low power photomicrograph of plasmacytoma of the nose showing the uniform cellular appearance of the tumor.

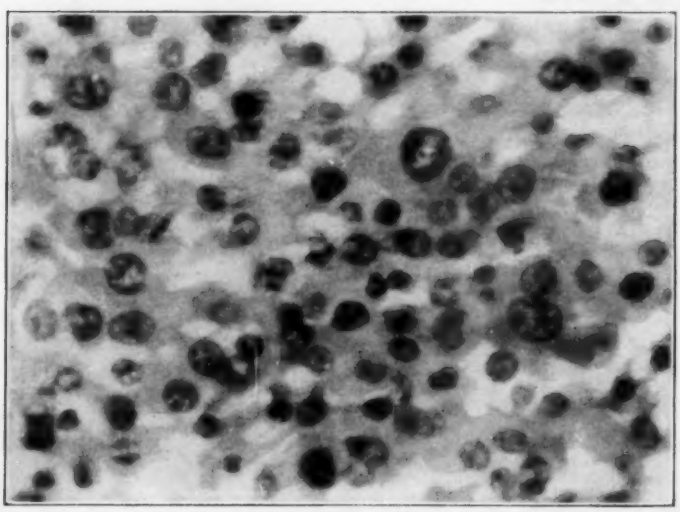

Fig. 3 (case 1).—High power photomicrograph of plasmacytoma of the nose. The nuclei appear darkly staining and vary in size. The clock-face appearance of the chromatin is seen.

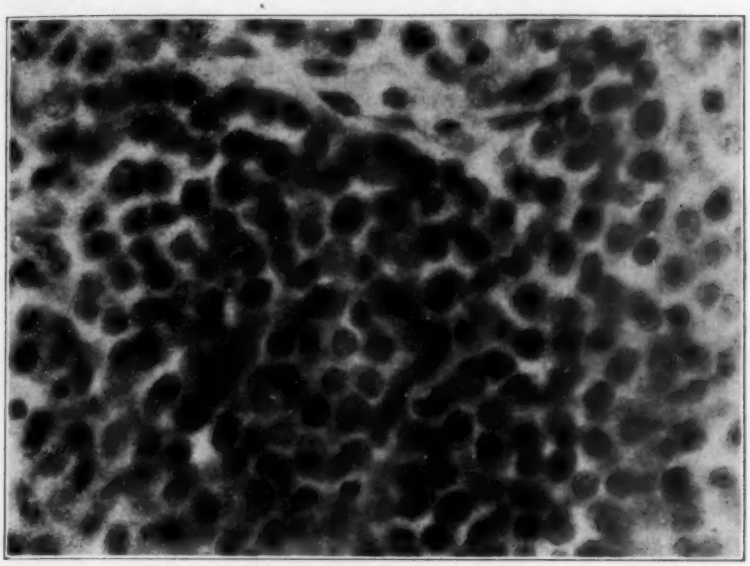

Fig. 4 (case 2).—High power photomicrograph of the multiple myeloma of the sternum. The cells are uniform in size with an occasional larger cell. The chromatin is arranged about the periphery. There is little stroma, and the plasma cells make up practically the entire tumor.

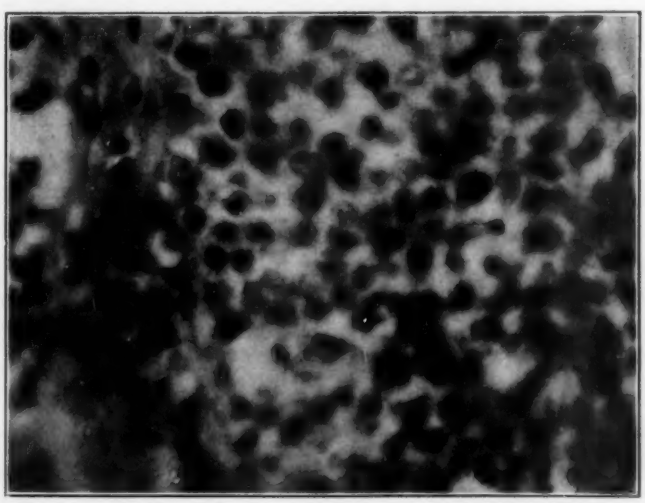

Fig. 5 (case 3).—High power photomicrograph of the plasmacytoma of the nasopharynx. The section is made up of plasma cells with pale staining eccentric nuclei and more darkly staining lymphocytes. The plasmacytoma is invading the normal lymphoid tissue of the nasopharynx; this accounts for the presence of both types of cells.

nucleus surrounded by a definite membrane. The nucleus contained many particles of chromatin which stained deeply and were, for the most part, arranged in the typical clock-face manner. There were occasional cells, much larger than the average, which contained two or three nuclei. The stroma was scanty. The whole histologic picture resembled that of the multiple myeloma which will be described (figs. 2 and 3).

In case 2, a biopsy specimen from the nasopharynx and one from the sternum were taken. The specimen from the sternum showed a very cellular tumor composed of round cells. The nuclei were round and eccentrically placed. Each contained several particles of chromatin. Occasionally, a multinucleated cell was seen. Mitoses were numerous. The stroma was scanty and consisted of delicate strands of connective tissue. A diagnosis of multiple myeloma was made (fig. 4). The biopsy specimen from the nasopharynx was a small nodular mass just lateral to the right eustachian orifice. Histologically, it was made up of cells similar in appearance to those previously described; the tumor was infiltrating the lymphoid tissue of the nasopharynx, so that the cells appeared to be both the invading plasma cells and the lymphocytes that are seen normally in the nasopharynx (fig. 5).

COMMENT

The most frequent plasmacytoma encountered is that of multiple myeloma of bone, and the relationship of plasmacytomas of the nose and nasopharynx to multiple myeloma must be considered. In one of our cases, the nasopharyngeal tumor was undoubtedly associated with a multiple myeloma, but in the other there was no roentgenologic evidence of skeletal involvement. The roentgenologic picture of multiple myeloma is diagnostic. Jackson, Parker and Bethea [5] reported a case which extended over a period of eight years before skeletal involvement was noted. Another case reported by them was one of multiple myeloma with nasopharyngeal involvement. They believed that multiple myeloma should be classed among the malignant lymphomas; it is not, in their opinion, limited to the bones, but may go from the bones to the soft tissue or vice versa. New and Harper [6] discussed their case solely from the point of view of multiple myeloma of the pharynx and cervical region without skeletal involvement.

In pathologic processes in the nose and throat, plasma cells are most frequently found in relation to chronic inflammatory conditions, includ-

5. Jackson, H.; Parker, F., and Bethea, J. M.: Studies of the Diseases of Lymphoid and Myeloid Tissue: II. Plasmacytomata and Their Relation to Multiple Myelomata, Am. J. M. Sc. **181**:169, 1931.

6. New, G. B., and Harper, F. R.: Plasma Cell Myeloma of the Pharynx and Cervical Region Without Skeletal Involvement, Arch. Otolaryng. **16**:50 (July) 1930.

ing syphilis and tuberculosis. Claiborn and Ferris expressed the belief that these may simulate neoplasms, but it is hard to conceive of collections made up entirely of plasma cells with a scanty amount of stroma as not being new growths. These authors believed that many plasmacytomas are benign neoplasms, and that most of the cases that appear malignant are manifestations of multiple myelomas. Rosenwasser [7] was of the opinion that plasma cells are derivatives of lymphoblasts, and that the plasmacytoma is a lymphoblastoma with more or less extensive cellular transformation to the plasma cell type. This places the plasmacytoma near lymphosarcoma of the nasopharynx.

SUMMARY

1. Two cases of plasmacytoma of the nose and nasopharynx are reported, one a proved case of multiple myeloma and the other a case in which there was no demonstrable skeletal involvement.

2. These tumors, which are composed of plasma cells, are rare.

3. The classification of plasmacytoma of the nose and nasopharynx is not certain, but I believe that they are of true neoplastic origin. According to reported cases, many of them may be relatively benign.

4. A careful roentgen examination of the skeletal system should be made in all cases of plasma cell tumor of the nose and nasopharynx to rule out multiple myeloma, which is rapidly progressive and leads to a fatal termination.

This study was made under the direction of Dr. H. P. Mosher in his laboratory at the Massachusetts Eye and Ear Infirmary. Dr. Tracy B. Mallory, Dr. John Bradley and Dr. Charles Kubik of the pathologic department of the Massachusetts General Hospital checked the slides. The second case, from the neurologic service of the Massachusetts General Hospital, is presented through the courtesy of Dr. W. J. Mixter.

243 Charles Street.

7. Rosenwasser, H.: Plasmacytoma of the Nasal Cavity, Laryngoscope **49**: 576, 1930.

CALCULI IN THE SUBMAXILLARY AND SUBLINGUAL GLANDS AND THEIR DUCTS

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Calculi in the submaxillary and sublingual gland or their ducts are not common. In contrast to stones in other regions of the body, particularly in the gallbladder and kidneys, those in the salivary gland have assumed a minor place. Nevertheless, they have been of sufficient interest to have been reported since the dawn of modern medicine. Hencke and Erdmann were able to collect approximately four hundred cases from the literature. In the past decade this number has been greatly increased.[1]

The calculi that occur in the gland proper do not, as a rule, give pronounced symptoms. They may be single or multiple. Béclère[2] reported a case in which a bilateral involvement of the submaxillary gland was found to be present. Calculi may manifest symptoms sufficient to warrant radical treatment, but fortunately, so far as the gland is concerned, this is the exception. This is the opinion of most surgeons, though some are inclined to differ, notably Bailey,[3] who believed that the submaxillary gland should be extirpated more often than it is. His more radical view, which has superseded his previous conservative attitude, is based on a greater experience with this pathologic condition. His reasons for a change of attitude are: 1. A recurrent calculus in Wharton's duct often signifies that other calculi are still present within the gland. 2. A relationship between the acute inflammation of the submaxillary gland and Ludwig's angina has been established.[4] 3. A negative roentgenogram does not eliminate the possibility of a stone. 4. The scar resulting from the removal of the gland can be made practically invisible. He cited cases to substantiate these opinions.

The anatomic dissections made by the author were made possible through the courtesy of the Dental School of the College of Physicians and Surgeons of San Francisco.

1. Risak, Erwin: Zur Klinik und Pathologie der Speichelsteinkrankheit, Deutsche Ztschr. f. Chir. **219**:206, 1929.

2. Béclère, Henri: Un cas de lithiase bilatérale des glandes salivaires, Arch. d. mal. de l'app. digestif **19**:1165, 1929.

3. Bailey, Hamilton: Stones in the Submaxillary Gland, Practitioner **126**: 671 (June) 1931.

4. Van Wagenen, W. P., and Costello, C. V.: Sublingual Phlegmon, Ann. Surg. **87**:684 (May) 1928.

Usually there are one or two calculi, though cases have been reported in which many have been found. This is the exception. Regardless of their number, they tend to obstruct a limited portion of the gland if located in that structure, or produce complete obstruction if located in the duct. The symptoms manifested are swelling and pain in a portion of, or in the entire, gland. Tenderness can frequently be elicited by palpation over the gland. New and Harper [5] in a comprehensive report based on a series of cases at the Mayo Clinic are inclined to believe that the most common symptom is the repeated exacerbation of an acute infection rather than the symptom of pain. From their experience they believe that probing the duct is dangerous. They stated that such treatment frequently causes an acute exacerbation of an underlying infection with the formation of a cellulitis.

Whether the calculi are single or multiple they have a tendency to be extruded by way of the main duct. Their size and consistency is such that during this attempt they become localized in some portion of this structure. Even those that meander as far as the outlet, the sublingual caruncle, cannot be extruded. This is easily understood, considering the small opening in the common orifice, for unless the calculus is extremely small, extrusion is anatomically impossible.

ETIOLOGIC FACTORS IN THE FORMATION OF CALCULI

Many theories have been advanced as to the etiologic factor causing the formation of these calculi. Inflammatory lesions of the gland proper seem to act as a precursor to the development of a calculus. This hypothesis must be accepted as a relative opinion, for if it were uniformly true many more calculi than can be demonstrated would occur. Epithelial débris in the smaller ducts has been demonstrated to serve as a nucleus in the formation of these stones.[6] Hamlin agreed with this.[7] He quoted Gallipe, who stated that the researches of Waldeyer, Boas and Klebs demonstrated that salivary calculi are usually composed of a central mass of bacteria. Naeslund [8] expressed the opinion that the ray fungus is the prime causative agent, and he cited a series of cases to substantiate this belief. His work corroborates a previous

5. New, G. B., and Harper, F. R.: Chronic Inflammation of the Salivary Glands With or Without Calculi, Surg., Gynec. & Obst. **53**:456 (Oct.) 1931.

6. Delannoy and Boury: Considérations sur la lithiase sous-maxillaire, Ann. d'anat. path. **8**:620 (June) 1931.

7. Hamlin, Fred E.: Calculus of the Submaxillary Gland and Duct, Arch. Otolaryng. **10**:177 (Aug.) 1929.

8. Naeslund, Carl: Fortgesetzte Untersuchungen über die Speichelsteinbildung unter besonderer Berücksichtigung ihres Verhältnisses zur Entstehung primärer Speicheldrüsenaktinomykose, Acta path. et microbiol. Scandinav. **6**:78, 1929.

investigation of Soderlund. He believes that the portal of entry is by way of the mouth. Though his researches demonstrate that the ray fungus is invariably the etiologic agent, he is not prepared to state that it is the only cause.

In clinical experience with a limited number of these cases, I have observed that a large percentage of persons with salivary calculi possess a so-called endocrine characteristic. This observation is strictly clinical. It leads me to believe that in persons of the long rangy type, with skeletal structures characterized by long strong bones and a cranium broad over the forehead and tapering to the lower jaw (comparable to the inverted triangle), salivary calculi are more prone to develop. The type that might be considered to belong to that great group is known as the preadolescent or postadolescent hyperpituitary type. This hypothesis based on six definitely proved cases of calculi, including one of actinomycosis, brings forth the interesting possibility of parathyroidal dysfunction. Whether the condition is due to pathologic changes, to altered chemistry in the parathyroids or to hormonal activity of other endocrine glands I am unable to state. This is a problem for the physiologist and chemist. This clinical observation, analyzed theoretically, brings forth the interesting subject of calcium metabolism. Other clinicians have made similar observations, especially Delannoy and Boury,[6] who quoted freely from the literature in regard to reports of cases of endocrine disturbances in lesions of this type. Their opinions are referable to thyroid and pancreatic dysfunction. No mention is made of the parathyroids. It seems that with our modern tendency to study calcium metabolism the possibility that these glands are an etiologic factor in the development of salivary calculi should not be ignored. I am well aware that patients with none of the physical characteristics mentioned present themselves. This might discount the hormonal theory but certainly not that of a dysfunction of the parathyroids per se. "He who does not go beyond the facts will seldom see the facts." [9]

Chemically, salivary calculi have been found to be composed of calcium carbonate and phosphate.[10] The potential chemical make-up of the subject is probably as important as any one cause in their formation. Those who, because of some inherent metabolic irregularity, are unable to handle their lime salts seem to be more inclined to the development of this condition. Sutherland [11] reported a case of calculus

9. Mayo, W. J.: Co-Ordination of Human Vegetative Functions, Surg., Gynec. & Obst. **38**:312 (March) 1924.

10. Da Costa, J. C.: Modern Surgery, Philadelphia, W. B. Saunders Company, 1926. Wakeley, C. P. G.: The Formation of Salivary Calculi and the Method of Treatment, Lancet **1**:708 (April 6) 1929.

11. Sutherland, D. M.: A Case of Parotid Calculus, Lancet **1**:1349 (June 20) 1931.

in the parotid gland. From a histologic study he was able to state definitely that no previous inflammation or foreign body was an etiologic agent. His observations led him to believe that the calculus was due to the precipitation of the constituents of the parotid secretion caused by some unknown alteration in the reaction of the gland.

TREATMENT

The treatment depends on the symptoms. Some cases can be let alone; many require surgical intervention. In a series of cases reported by Philip[12] from Portmann's clinic over a period of six years, the statement was made that a calculus may develop clinicopathologic signs and symptoms varying from no apparent manifestations when the location is in Wharton's duct to a submaxillary suppuration with phlegmon of the neck. When a patient with a small tumor-like mass in the floor of the mouth presents himself, it becomes necessary to determine what this pathologic condition may be and how it can best be remedied. Bode[13] is of the opinion that the differential diagnosis is the most important single factor in the treatment of these conditions. He believes that, owing to an error of omission or commission, precautions are not always taken to eliminate the possibility of a malignant condition of the floor of the mouth. This is especially true when one trusts entirely to bimanual palpation. The diagnosis is not difficult if ordinary precautions are used. One must continually keep in mind the lesions that must be excluded. Calculus must be differentiated from cancer of the floor of the mouth. When the gland is involved and signs and symptoms are demonstrated, the condition must be differentiated from submaxillary lymphadenitis, actinomycosis, carcinoma of the mixed type and the specific granulomas, especially tuberculosis and syphilis.

The presence of transitory pain with swelling and tenderness over the gland proper frequently causes the patient to consult a physician. The history may be similar to that of biliary or renal colic.[2] By bimanual palpation a small tumor-like mass may be felt. The roentgenogram usually adds evidence. Some writers have stated that roentgen study with the use of contrast mediums, such as iodized poppy-seed oil, 40 per cent, injected into the duct, overcomes the danger of error in diagnosis.[14]

It is my opinion that in a limited number of cases probing the duct will suffice. One patient whom I treated was certainly relieved by this

12. Philip, Raymond: La lithiase sous-maxillaire, Rev. de laryng. **52**:476 (Aug.) 1931.

13. Bode: Zur Pathologie und Therapie der Speichelsteinerkrankung, Deutsche Ztschr. f. Chir. **227**:488, 1930.

14. Barraud, Albert: Méthode moderne d'exploration des canaux et des glandes salivaires, Acta oto-laryng. **17**:313, 1932.

method. The calculi were multiple, and apparently one of the smaller concretions had become fixed in the duct. When this was loosened the others were extruded over a period of time.

The anatomy of the floor of the mouth is complicated, and unless a thorough knowledge of this is continually kept in mind any surgical procedure in this region may be fraught with danger. The vascular structure, the lingual artery with its branches, the submental and dorsalis linguae arteries (fig. 1 *A*), if injured may cause a tremendous amount of embarrassment. Two important nerves, the lingual and the hypoglossal, are in close proximity to the submaxillary gland and duct

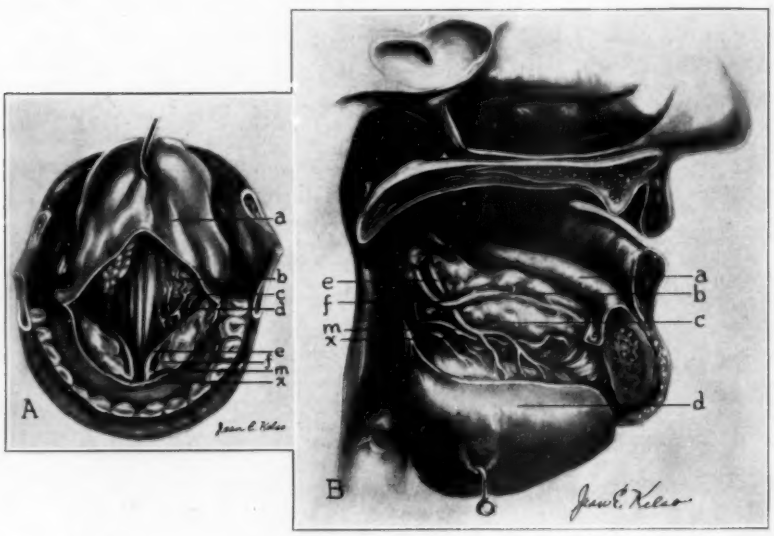

Fig. 1.—*A*, the tongue is lifted upward. The drawing shows: *a*, the tongue; *b*, the lingual nerve; *c*, the lingual artery with the submental branch; *d*, the dorsalis linguae artery; *e*, the submaxillary duct; *f*, the sublingual gland; *m*, the main duct of the sublingual gland; *x*, the caruncle. *B* shows: *a*, the divided inferior maxilla; *b*, the submaxillary duct; *c*, the lingual nerve; *d*, the tongue retracted; *e*, the lingual nerve; *f*, the submaxillary duct; *m*, the lingual artery with its branch the dorsalis linguae; *x*, the hypoglossal nerve. The view is from the inner aspect of the left side of the floor of the mouth. These and the following illustrations are drawings of dissections made by the author.

(fig. 1 *B*). In addition the submaxillary ganglion is not far distant (fig. 2). It possesses sympathetic fibers. I believe that the more than occasional occurrence of surgical shock in technical procedures about the floor of the mouth can be explained on the basis of trauma to this ganglion. During the past few years I had two patients brought to the threshold of death, with all evidence of surgical shock, during

operative procedures on the floor of the mouth, in one instance for a calculus and in the other for an abscess, and I have a deep and wholesome respect for any surgical manipulation in this area.

The tissues of the floor of the mouth possess a great range of motion. This is necessary because of the mobility of the tongue. It makes fixation of a definite structure difficult, and this seems to be the chief difficulty encountered in any operative work on the submaxillary duct. This necessitates a thorough knowledge of the course and relation of this structure. If the calculus is of such a size that it can be held in a fixed position its removal is not difficult, but unfortunately this is not possible with most of the calculi that are to be removed; for they are usually of the size of a pea or coffee bean, and any method other

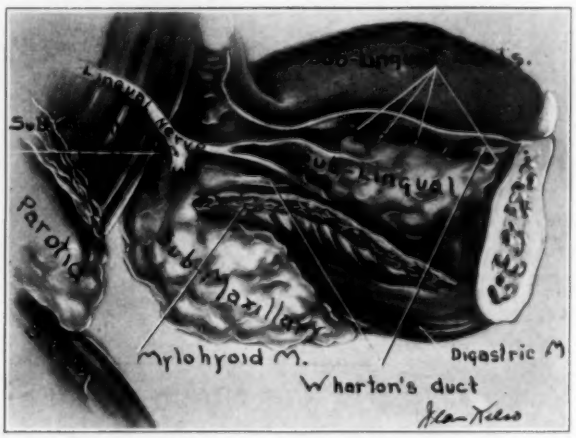

Fig. 2.—Structures involved in surgical removal of submaxillary calculi.

than a careful dissection may bring grief. It is self-evident that when they are walnut-sized their removal is simple.

Many surgeons prefer the use of local, while others favor general, anesthesia. I prefer the latter given with an intranasal catheter. It serves as a safeguard in case one gets into trouble. Should severe bleeding occur, this emergency can be more readily controlled under general anesthesia. The tongue is held laterally with a Lille tongue depressor or with a sponge forceps. A longitudinal incision is made through the mucous membrane over the course of the duct, the length forward or backward depending on the determination of the calculus by any of the diagnostic methods mentioned. The duct is isolated by sharp dissection. As this structure is quite mobile, a transfixion suture of black silk is placed beneath the duct. This is utilized for traction. The duct is thus made taut and relatively fixed; it is then opened and

the calculus removed (fig. 3 *A*). Some close the duct with fine catgut; others permit it to close spontaneously. The possibility of stricture must always be kept in mind.

When a calculus is in the immediate vicinity of the submaxillary gland or in the gland proper the removal of the gland may become necessary. Again the anatomy and surgical relations are of paramount

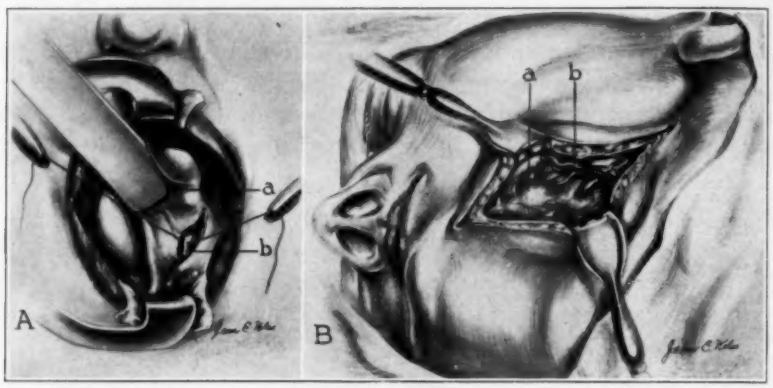

Fig. 3.—*A* demonstrates: *a*, the elevated tongue; *b*, the dissected submaxillary duct with retention suture beneath. *B* demonstrates: *a*, the submaxillary gland; *b*, the facial vein. The artery is deeper and cannot be seen.

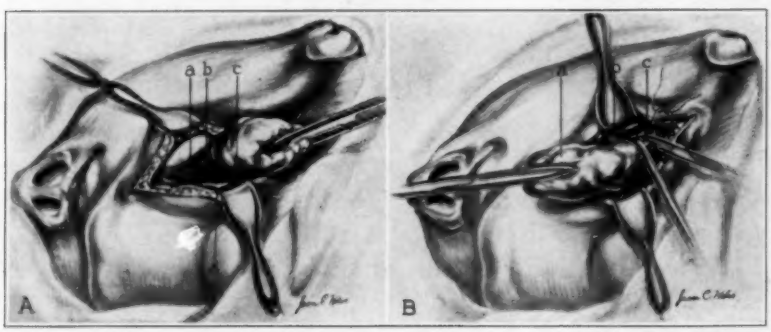

Fig. 4.—*A* demonstrates: *a*, the digastric muscle; *b*, the submaxillary duct; *c*, the submaxillary gland; *d*, the hypoglossal nerve. The position and retraction have somewhat altered the normal anatomic position of the structures described. *B* demonstrates: *a*, the submaxillary gland; *b*, the ligated facial artery; *c*, the clamp and suture on the duct. In this picture the gland is pulled forward so as to expose the duct more easily and aid in orienting adjacent parts, so as to avoid injury to them.

importance. The removal is accomplished through an inframandibular incision (fig. 3 *B*). The difficulties encountered are the facial vessels and lingual artery. The lingual nerve as it enters the floor of the mouth may be injured. The submaxillary gland lies under the mandible in the

submaxillary fossa; in addition to the mandible being external to it, it is in relation with a portion of the external pterygoid muscle. Medially it is in relation with the mylohyoid, stylohyoid digastric and hyoglossus muscles. The gland is usually composed of two portions: cervical and buccal. The buccal is the posterior portion and enters the oral cavity by extending around the posterior margin of the mylohyoid muscle (fig. 4 *A*). The gland is separated from the parotid by the stylomandibular ligament. This structure may be injured in the process of removal. The hypoglossal nerve is not far distant and must always be kept in mind. The gland, irregular in outline as it is, tends to make complete removal difficult. A salivary fistula may be the result. If the main portion has been removed and the duct closed this fistula tends to close spontaneously (fig. 4 *B*).

When calculi occur in the sublingual duct or gland their removal is usually quite simple. An incision over the calculus usually suffices. The anterior duct of the sublingual gland is the largest. It joins with the submaxillary to empty at the caruncle (fig. 1). It is the place of election for a stone; when the calculus is in the gland proper, removal of this structure is frequently necessary. It is in a more fixed position than the submaxillary duct and is in close relation with the mandible, making fixation easy. Removal of the calculus or of the entire gland is therefore relatively simple.

CONCLUSIONS

1. Submaxillary and sublingual calculi are not common.
2. The diagnosis is not difficult.
3. Treatment, when indicated, is surgical.
4. Operative removal is frequently difficult.
5. The anatomy of the structures involved and their surgical relations are of great importance.
6. The submaxillary ganglion is probably a factor in causing some of the unpleasant complications that may occur in surgical procedures on the floor of the mouth.

THE MASTOID CELLS

THEIR ARRANGEMENT IN RELATION TO THE SIGMOID PORTION OF THE TRANSVERSE SINUS

PHILIP E. MELTZER, M.D.
BOSTON

The placing of the mastoid operation by Schwartze on a rational anatomic basis awakened a tremendous interest in the study of the development of the mastoid. The first studies consisted chiefly of descriptions of the structure of the mastoid.

The next advance in the knowledge of this structure came with an inquiry into the development of the air spaces. The fundamental basis for the present knowledge of the pneumatization of the mastoid must be credited to Wittmaack. His work has been augmented by the more recent researches of Albrecht and Schwarz. I shall not go into the detailed description of the successive stages of development of the tympanum, attic, antrum and mastoid cells. Stated simply, according to Wittmaack's [1] theory, the pneumatization of the temporal bone is the result of a transformation due to the successive displacement of the myxomatous embryonic tissue in the preformed cavities by the epithelium. The development of the cells about the antrum into the mastoid is the result of a concentric indentation of the subepithelial tissues into the surrounding structure of the bone. In other words, the changing of the middle ear and its recesses into an air-containing space is dependent on the character and activity of the epithelium, while the air spaces extending from the antrum, the tip of the petrous bone and the mastoid are the result of activity of the subepithelial tissues. Accordingly, Wittmaack considered the pneumatic cellular mastoid an indication that the mucosa is normal, and that any disturbance in pneumatization, resulting in a cellular development other than the pneumatic type, is the result of an influence which altered the histologic structure of the middle ear and the antral mucosa. This influence he attributed chiefly to inflammation occurring at or during infancy.

As the arrangement of the mastoid cells in relation to the sigmoid portion of the transverse sinus (designated as the lateral sinus from now on) is dealt with in this paper, it is not beside the question to relate briefly modern theories of pneumatization.

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1. Wittmaack, K.: Internat. Zentralbl. f. Ohrenh. **17**:19, 1919; Arch. f. Ohrenh-, Nasen- u. Kehlkopfh. **129**:207, 1931.

The view of Wittmaack wherein an attempt is made to explain the disturbances of pneumatization by purely secondary changes in the mucosa was slightly modified by him recently after Albrecht called attention to the hereditary or constitutional influence on the process of pneumatization. Albrecht [2] was of the opinion that external influences, such as otitis and nutritional disturbances undoubtedly play a rôle in the occurrence of various types of mucosa, but that the greatest rôle is actually played by the constitution. The origin of the inner structure of the mastoid process is chiefly dependent on the activity of the mucosa, therefore dependent on the anlage, and is consequently inherited to a certain extent.

Schwarz [3] concurred with Albrecht that the inherited constitutional character of the mucosa plays an important rôle in the pneumatization of the middle ear and mastoid process. This statement is based on the roentgenologic examination of fifty-nine uniovular and thirty-five biovular pairs of twins and three sets of triplets. The studies revealed a more or less identical picture of the mastoid in 66.1 per cent of the uniovular twins, while the similarity of the mastoids occurred in but 37.1 per cent of the biovular twins. In a more recent article [4] Schwarz reported on the histologic examination of one hundred and one temporal bones obtained from new-born infants and human fetuses at varying stages of development and reaffirmed his belief in this theory, relegating to the subepithelial tissues as great an importance in the rôle of pneumatization as that credited to the epithelium by Wittmaack.

Long before the advent of these histologic studies, Cheatle [5] and Mouret believed that the different types of cells developed in the mastoid were normal for that particular individual. They both recognized the sclerosed mastoid as being an indication of a pathologic state, while a compact mastoid indicated an anatomic condition.

SIGMOID PORTION OF THE TRANSVERSE SINUS

The variable position and course of the lateral sinus in the mastoid process has been recognized by practically every author who has written concerning the mastoid. Mouret,[6] Neumann and others have given classic descriptions of the cells in relation to the lateral sinus from the surgical standpoint, stressing the importance of the exenteration of these cell blocks. No suggestion is made, however, as to when such an arrange-

2. Albrecht, W.: Acta oto-laryng. **14**:221, 1930.

3. Schwarz, M.: Arch. f. Ohrenh-, Nasen- u. Kehlkopfh. **123**:161, 1929.

4. Schwarz, M.: Arch. f. Ohrenh-, Nasen- u. Kehlkopfh. **129**:1, 1931.

5. Cheatle, A. H.: Surgical Anatomy of the Temporal Bone, London, J. & A. Churchill, 1907; J. Laryng. **22**:256 (June) 1907.

6. Mouret, J.: Internat. Cong. Med., Sect. Otol., London, 1913.

ment is to be expected. So it is throughout the textbooks. No inkling is given of the relationship of the mastoid cells and their arrangement to the position of the lateral sinus, other than to state that the sinus may be superficial or deep, or that it may approximate the antrum or wall of the canal. Barnhill and Wales [7] did state that the relative position of the lateral sinus determines the size and shape of the mastoid.

The contention is that mastoid cells, when present, are arranged in a systematic manner, and this arrangement is dependent on the course and position that the lateral sinus assumes in relation to the cortex of the squama posterosuperiorly, to the cortex of the mastoid laterally and posteriorly, to the digastric crest or medial margin of the tip of the mastoid inferiorly, and last, to the posterior wall of the canal from the level of the lateral semicircular canal to where the wall of the canal merges with the medial or digastric crest of the tip (the facial ridge).

It will not matter whether the cells are large or small, pneumatic diploic or mixed, the arrangement will be systematic according to the relationship to the structures mentioned in the preceding paragraph.

Confusion must not arise between arrangement of cells and pneumatization. The arrangement of cells, as will be shown, depends on the position of the lateral sinus, while the type of pneumatization will depend on the constitutional or inherited character of the epithelium and subepithelial tissues present at birth, it being agreed that inflammation may alter these tissues after birth, thereby interfering with the process of pneumatization.

CLASSIFICATION OF CELLS

The anatomic classification of the mastoid cells as described by Mouret is most complete but too detailed for common usage. Neumann's classification is excellent but does not give me the latitude I desire in order to emphasize the relationship; therefore, without intending to add confusion to an already overtaxed nomenclature, I introduce the terminology used by myself and associates who have helped me in preparing some of the specimens. We distinguish three groups of cells to be subdivided as follows (fig. 1):

I. *Superior Group.*—(*a*) Anterosuperior Cells: This group includes the superficial and deep zygomatic cells.

(*b*) Posterosuperior Cells (Angle, Petrosal Cells): This group includes the cells underlying the tegmen mastoideum and occupies

7. Barnhill, J. F., and Wales, E. de W.: Principles and Practice of Modern Otology, Philadelphia, W. B. Saunders Company, 1907.

the angle formed by the anterior and posterior surfaces of the temporal bone. These are the important cells extending posteriorly from the antrum to where the lateral sinus joins the cortex of the squama. Occasionally the cells of the angle extend into the parietal and occipital bones where they come together at this point.

II. *Antero-Inferior Group.*—(*a*) Cells of the Posterior Wall of the Canal and the Tip: These cells, extending from the antero-inferior margin of the antrum along the posterior wall of the canal, include the cells at the tip as far back posteriorly as where the digastric crest joins the cortex. The cells lie above a plane passing horizontal to the facial canal. The deeper cells of the canal wall coalesce with the next group, when present.

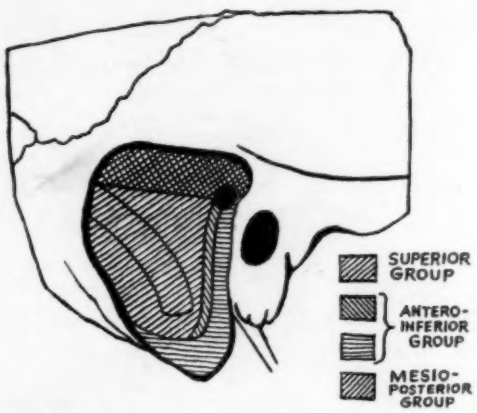

Fig. 1.—Schema of general cell group arrangement.

(*b*) Retrofacial Cells: These cells lie posterior and medial to the facial canal. Superiorly, they come in contact with the deep subantral cells around the lateral and posterior semicircular canals, and inferiorly, with the cells overlying the lateral sinus in the direction of the jugular bulb. The extent of the development of these cells is quite dependent on the position of the lateral sinus.

III. *Mesioposterior Group.*—These cells are the intermediate group lying interposed and coalescing with the superior and antero-inferior groups. They make up the greater mass of cells and lie in front of, immediately over and posterior to the lateral sinus. The posterior cells are commonly designated as the peripheral or marginal cells, lying above and below the emissary vein.

The sublabyrinthine and perieustachian tube groups of cells are not mentioned here because they do not play any rôle in relation to the lateral sinus.

ANATOMIC STUDY

With this introduction, I present the conclusions based on observations which have continued over a period of twelve years. The material consisted of many hundred dissections of temporal bones provided from the anatomic laboratories of Harvard and Tufts Medical Schools. Several hundred more observations were made over this period during mastoidectomy on house patients from the regular services at the Massachusetts Eye and Ear Infirmary, as well as a limited number from private practice.

The anatomic material furnished me did not include any children's temporal bones, but a sufficient number of observations were made on children operated on at the Massachusetts Eye and Ear Infirmary to warrant the following statements:

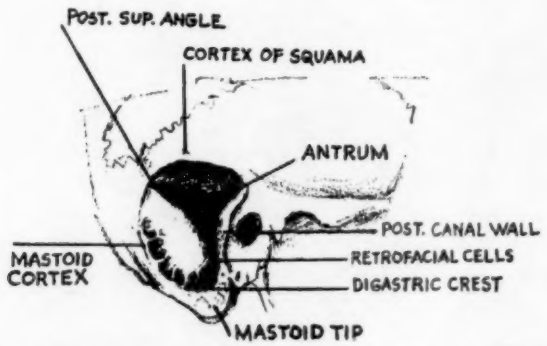

Fig. 2.—Anatomic structures referred to in descriptive text.

In infants it has long been observed that the lateral sinus does not play an important rôle so far as relation to the antrum and cortex is concerned. As the child develops, the forces of normal growth may or may not cause the sinus to take a prominent position in the mastoid. It it does, and enters into relationship with the structures mentioned in the preceding paragraphs, the descriptions which are to be given will hold true in the child as well.

Figure 2 shows the anatomic parts of the mastoid in relationship to the lateral sinus plate.

Figure 3 shows the pyramidal-shaped mastoid in which the surface of the middle fossa, cerebellar surface and posterior wall of the canal form three sides of a pyramid, with the antrum as its apex and the cortex of the mastoid process as its base. In this type the lateral sinus makes no bulge into the mastoid, or at most only a slight one. The plate of bone over the lateral sinus designated as "sinus plate" blends with the cortex of the mastoid posteriorly, along its entire course. It will be noted that the sinus as it makes its bend backward at the

posterosuperior angle is in contact with the cortex of the squama in this region. This union of the sinus plate with the cortex is the factor which inhibits the pneumatization so that the marginal cells cannot develop posterior to the sinus, nor will there be any cells of the posterosuperior angle beyond this point. It will be noted also that the sinus

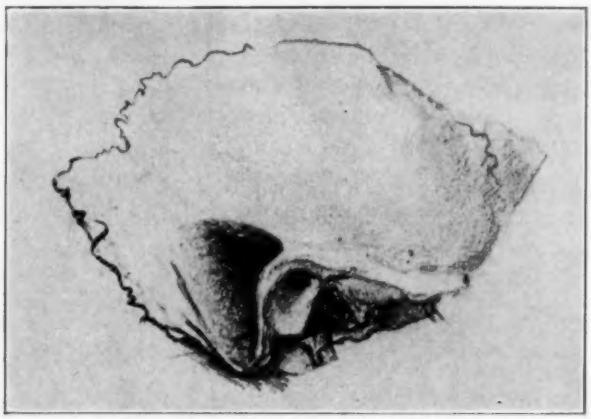

Fig. 3.—A type of mastoid structure in which the position of the lateral sinus limits irregular cell development.

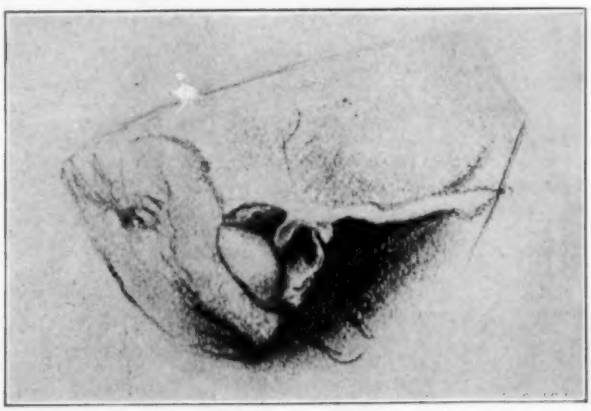

Fig. 4.—A type of mastoid in which the cells develop only superiorly.

plate is in contact with the digastric crest, leaving no bone tissue into which cells may develop; therefore, none will develop medial to the tip toward the region of the bulb. The retrofacial cells will be very shallow if they develop at all.

Figure 4 shows the lateral sinus in contact with the posterior wall of the canal and the lateral surface of the mastoid. It does not come in contact with the cortex of squama immediately over the antrum but

blends with it about 1 cm. posterior to the suprameatal spine. In this type it will be noted that pneumatization cannot take place antero-inferiorly or mesioposteriorly. In other words, the cells along the wall of the canal and tip as well as the cells overlying the sinus and those posterior to it are prevented from developing. On the other hand, the sinus plate, being away from the cortex of the squama, permits cellular development posterosuperiorly even though limited in extent. Obviously retrofacial and peribulbar cells cannot develop, as the descending portion of the facial canal is in close relation to the sinus.

Figure 5 shows the lateral sinus deep, away from the cortex of the mastoid but close to the floor of the antrum and in contact with the bone medial to the facial ridge. This position permits cells to develop

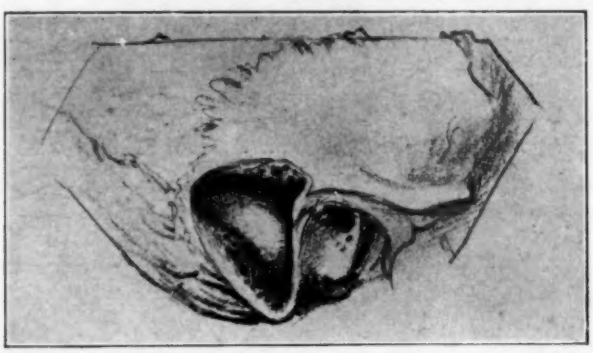

Fig. 5.—Broad cell development with the exception of the retrofacial group.

freely antero-inferiorly and mesioposteriorly, as there is considerable space between the sinus plate and the cortex laterally. No retrofacial or peribulbar cells will develop, however, because the sinus plate is in contact with the facial ridge along its descending course and also with the digastric crest where it joins the facial ridge. The cells of the posterosuperior angle develop only to where the turn of the sigmoid sinus is made into the transverse sinus at the point where the sinus plate blends with the cortex of the squama.

Figure 6 shows the sinus traversing the mastoid cavity posteriorly; here the sinus plate is in contact with the cortex of the mastoid. It will be noted also that the sinus as it dips downward beneath the tip is in contact with the posterior margin of the digastric crest. No marginal cells have developed posterior to the sinus or between the digastric crest and the sinus. There will be a retrofacial development anterior to and over the lateral sinus. This type usually has a deep

posterosuperior angle into which cells develop, the posterior limit being at the point of union of the sinus plate and the cortex of the squama.

Figure 7 shows a development somewhat similar to that shown in figure 6. The difference is that the sinus is much farther away from the cortex of the squama, permitting an extensive development of the

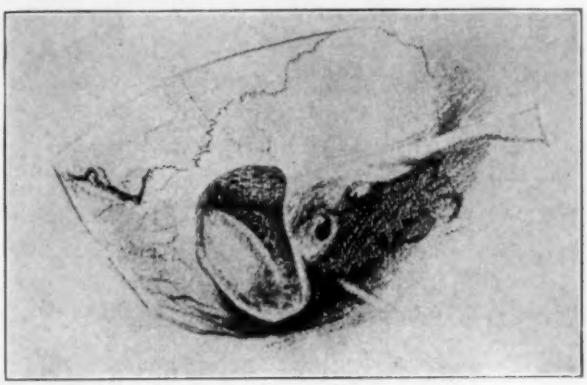

Fig. 6.—Illustration showing why cells fail to develop posteriorly behind the lateral sinus.

Fig. 7.—Extensive posterosuperior angle cell development.

cells of the posterosuperior angle. It differs also in that the sinus plate does not come in contact with the digastric crest, so that cells develop between the crest and the sinus plate. There are no posterior marginal cells because the sinus plate is in contact with the cortex in this region. Because of the position of the sinus plate, away from the crest and wall of the canal, the retrofacial group will develop freely and will

connect with the cells overlying the sinus medial to the digastic crest. The deep and broad development in the upper portion of the mastoid should be noted.

Figure 8 shows just the opposite development to that depicted in figure 7. The sinus is making a sharper bend into the mastoid closer

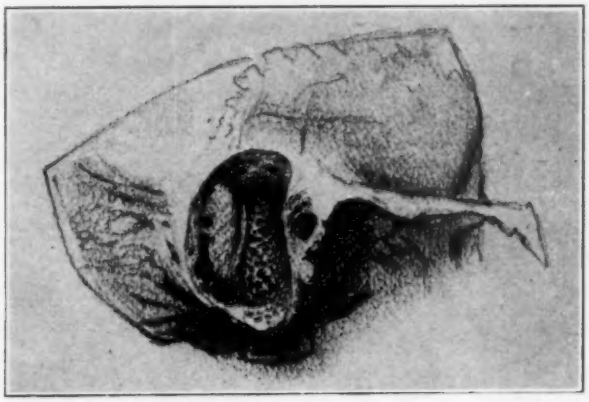

Fig. 8.—Illustration showing why posterosuperior angle cells do not develop.

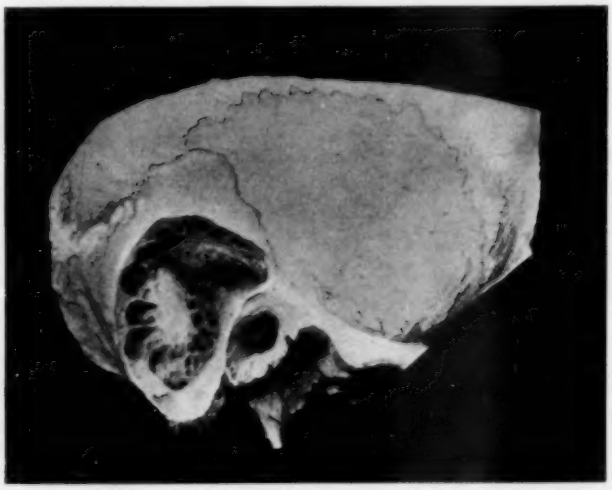

Fig. 9.—Extensive cell development because of the deep position of the lateral sinus.

to the antrum; it descends almost vertically—deep to the posterior margin of the digastric crest. This position permits free development antero-inferiorly, retrofacially and mesioposteriorly. The cells develop extensively anterior, lateral and posterior to the sinus. Because of the space between the sinus plate and the digastric crest, there will be a

deep development of cells overlying that portion of the sinus, and they will extend into the peribulbar region.

The cells of the posterosuperior angle are not well developed because the sinus is nearer the antrum and the sinus plate is in approximation with the cortex of the squama. The narrow development of the upper portion of the mastoid is to be noted.

Figure 9 shows the lateral sinus traversing the mastoid deeply. The sinus plate is nowhere in contact with the bony surfaces or margins which will inhibit the process of pneumatization. Here are seen the large mastoid cavity with cells extending deep into the posterosuperior angle, deep retrofacially as well as medial to the digastric crest. The marginal cells are well developed and frequently extend into the occipital bone. The cellular development will be limited posterosuperiorly definitely at the point where the sinus plate blends with the cortex of the squama.

CONCLUSIONS

1. It is evident that the lateral sinus does not influence the type of pneumatization; this is dependent on the character of the epithelium and subepithelial tissues.

2. It would appear that the position of the lateral sinus in relation to the structures mentioned (cortex, digastric crest, posterior wall of the canal, etc.) determines to what extent the pneumatization will occur and causes a definite arrangement of the cells in relation to it.

3. Clinically, unless stereoscopic roentgenograms are made of the mastoid, the arrangement of cells as shown on the film will be indefinite, particularly that of the deep cells. Once the sinus plate is exposed and its position in relation to the structures named is noted, the cellular pattern of the mastoid becomes known, and it will be nothing short of negligence to fail to uncover the remotest cell.

4. The course and relations of the lateral sinus offer to the surgeon an interior landmark of the structure of the mastoid comparable in importance to the external landmarks used as a guide in locating the antrum.

ETIOLOGY AND PATHOLOGY OF PARALYSIS OF THE ABDUCENS NERVE ASSOCIATED WITH SINUS THROMBOPHLEBITIS

REPORT OF A CASE OF THROMBOSIS OF THE LATERAL SINUS AND BILATERAL PARALYSIS OF THE ABDUCENS NERVE; OPERATION AND RECOVERY

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BROOKLYN

Paralysis of the abducens nerve is the commonest of isolated oculo-orbital palsies.[1] Bilateral occurrence is exceedingly rare. In regard to the etiologic factors, reference is here made solely to those peripheral causes which may involve the nerve trunk in its intracranial course after leaving the brain stem.

The occurrence of this condition secondary to disease of the petrous tip is fairly common and has of late occupied no small share in otologic literature. Gradenigo,[2] in 1904, first identified palsy of the external rectus with suppurations of the middle ear and thereby established the clinical entity or syndrome which was accepted by otologists for many years. Perkins,[3] in 1910, outlined rather generally the various pathways through which infection from the tympanum and mastoid gained access to the petrous pyramid. As time went by, the conception of the pathologic processes involved became more and more lucid as a result of continued investigation and study. This knowledge was further enhanced by the appearance in the literature of reports of numerous cases in which detailed and careful clinical postmortem observations, both macroscopic and microscopic, were made.[4] As a result

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Read before the otolaryngologic section of the King's County Medical Society, May 10, 1933.

1. Sears, W. H.: Isolated Paralysis of External Rectus Muscle in Acute Suppurative Otitis Media, Pennsylvania M. J. **13**:844, 1910.

2. Gradenigo, G.: Ueber die Paralyse des Nervens Abducens bei Otitis, Arch. f. Ohrenh. **74**:149, 1904.

3. Perkins, C. E.: Ann. Otol., Rhin. & Laryng. **19**:692, 1910.

4. Wilkinson, G. B.: A Case of Paralysis of the External Rectus Muscle Due to the Presence of an Abscess in the Apex of the Petrous Pyramid, J. Laryng. **29**:409, 1914. Wheeler, J. M.: Paralysis of the Sixth Nerve Associated with Otitis Media, Tr. Sect. Ophth., A. M. A., 1918, p. 51. Boonacker, A. A., and Huizinga, E.: Ueber Abducenslähmung bei akuter Mittelohrentzündung, Zentralbl. f. Hals-, Nasen- u. Ohrenh. **11**:207, 1927-1928. Profant, H. J.: Gradenigo's Syndrome, with a Consideration of "Petrositis," Arch. Otolaryng. **13**:347 (March) 1931. Lillie, H. I., and Williams, H. L.: Suppuration of the Petrous Pyramid, Arch. Otolaryng. **15**:692 (May) 1932.

of the more recent investigations of Eagleton,[5a] Kopetzky and Almour,[6] Friesner and Druss [7] and others, involvement of the abducens nerve in its course over the petrous ridge in cases of suppuration of the tip is now based on a well established, scientific, pathologic foundation to which, I am sure, no otologist today would take exception. The ultimate involvement of the nerve is the result of extension of the infectious process from the middle ear and mastoid cavity by direct bony continuity.

However, this type of involvement must fail to embrace the occurrence of palsy of the external rectus in connection with thrombophlebitis of the lateral sinus. In the latter case the cells of the petrous pyramid are not involved and do not serve as the pathway through which infection or the reaction to infection gains access to the dura in the vicinity of the sixth nerve. The case herein reported is one that falls in this category. The clinical course and termination preclude the existence of disease of the petrosa as an etiologic factor in the production of paralysis of the abducens. The patient had none of the cardinal signs indicative of so-called petrositis. The middle ear was dry immediately after operation on the mastoid and remained so throughout the course of the illness. The patient at no time complained of supra-orbital or retrobulbar pain. It is evident, therefore, that one must seek another explanation for paralysis of the sixth nerve occurring in connection with thrombophlebitis of the lateral sinus.

In my endeavor to account for the bilateral involvement observed in this case I shall briefly refer to the anatomy of the abducens nerve and of the superior and inferior petrosal sinuses, the relationship of the abducens nerve to its fellow on the opposite side and the proximity of the nerves to the petrosal sinuses.

THE ABDUCENS NERVE

The abducens nerve emerges by numerous rootlets at its superficial origin on the anterior surface of the hindbrain in the groove between the lower edge of the pons and the medulla oblongata, just lateral to the pyramid (fig. 1). In the first part of its intracranial course the nerve is flat and is closely applied to the pons for a distance

5. Eagleton, W. P.: (*a*) Unlocking of the Petrous Pyramid for Localized Bulbar (Pontile) Meningitis Secondary to Suppuration of the Petrous Apex, Arch. Otolaryng. **13**:386 (March) 1931; (*b*) personal communication, March 15, 1933.

6. Kopetzky, S. J., and Almour, R.: Suppuration of the Petrous Pyramid, Pathology, Symptomatology and Surgical Treatment, Ann. Otol., Rhin. & Laryng. **39**:996, 1930; **40**:157, 1931.

7. Friesner, I., and Druss, J. G.: Osteitis of the Petrous Pyramid of the Temporal Bone, Arch. Otolaryng. **12**:342 (Sept.) 1930.

of about 15 mm., being contained in the cisterna pontis of the subarachnoid space; it is invested by the arachnoid membrane 15 mm. from its origin, becomes rounded and pierces the dura opposite the dorsum sellae of the sphenoid, medial to and slightly behind the opening for the fifth nerve, on the medial aspect of the inferior petrosal sinus (fig. 2). It then bends slightly laterally through the commencement of the sinus to reach its lateral aspect, passes forward through the notch between the apex of the petrous bone and the posterior clinoid process, where it lies under the petrosphenoidal ligament, and enters the cavernous sinus. Here it is closely related to the inferior petrosal

Fig. 1.—The base of the brain showing the points of exit of the cranial nerves. The significance of the numerals is: *1*, optic nerve; *2*, oculomotor nerve; *3*, trochlear nerve; *4*, trifacial nerve; *5*, facial nerve; *6*, acoustic nerve; *7*, medulla oblongata; *8*, course of the abducens nerve; *9*, pons, and *10*, point of exit of the abducens nerve.

sinus, the two passing together into the cavernous sinus through Dorello's canal.[8] The nerve then enters the orbit by way of the oculomotor foramen and is distributed to the fibers of the external rectus muscle (fig. 3). The abducens nerves are in close relationship to one another. At their points of emergence they are approximately from 5 to 6 mm. apart. They continue at this proximity for a distance of 15

8. Vail, H. H.: Anatomic Studies of Dorello's Canal, Laryngoscope **32**:569, 1922.

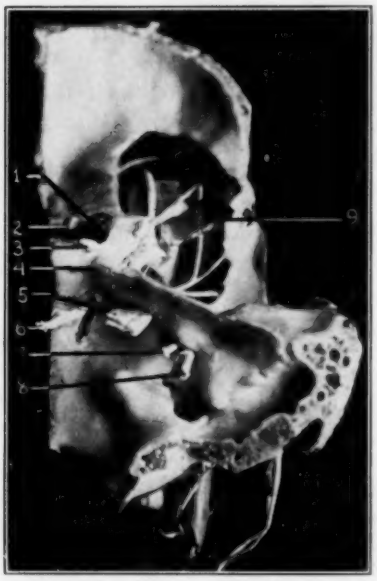

Fig. 2.—Posterosuperior view of the posterior cranial fossa. *1* indicates the internal carotid artery; *2*, the optic nerve; *3*, the oculomotor nerve; *4*, the trochlear nerve; *5*, the trifacial nerve; *6*, the abducens nerve; *7*, the facial nerve; *8*, the acoustic nerve, and *9*, the external rectus muscle.

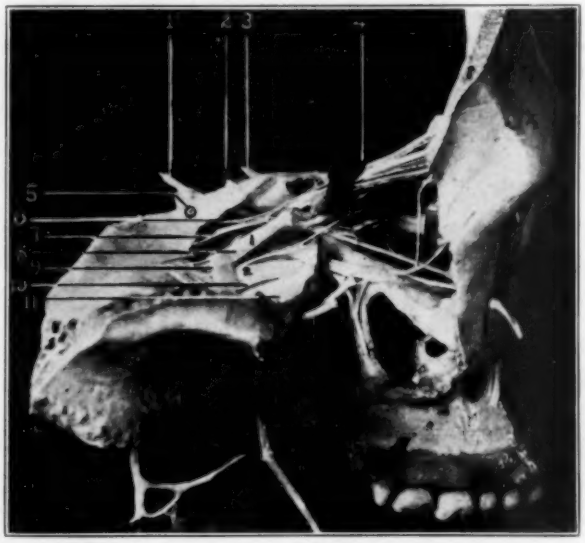

Fig. 3.—Lateral view of the open orbit and the adjacent middle fossa. *1* indicates the oculomotor nerve; *2*, the internal carotid artery; *3*, the optic nerve; *4*, the external rectus muscle cut and turned up; *5*, the Dorello canal area under which pass both the abducens nerve and the inferior petrosal sinus; *6*, the trochlear nerve; *7*, the abducens nerve; *8*, the first division of the trifacial nerve; *9*, the gasserian ganglion; *10*, the second division of the trifacial nerve, and *11*, the third division of the trifacial nerve.

mm. They then diverge slightly to reach the lateral aspect of the inferior petrosal sinus. It is owing to this close association that bilateral involvement is so often noted in fractures at the base of the skull and in basilar meningitis. Similarly, in conditions producing edema of the dura in the vicinity of one nerve, the process readily extends beyond the midline to involve the sixth nerve of the other side.

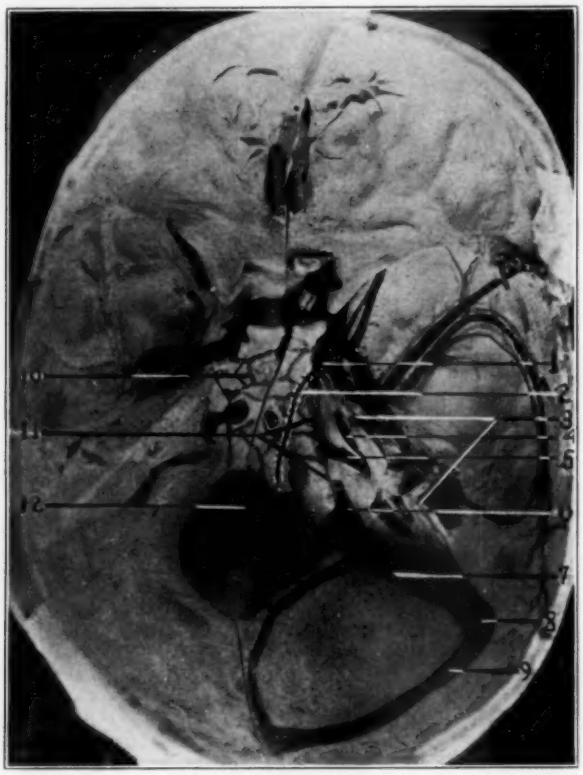

Fig. 4.—The base of the skull as seen from above. *1* indicates the cavernous sinus region, and *2*, the course of the abducens nerve after it leaves the brain stem. It is in close contact with the inferior petrosal nerve. *3* indicates the course of the superior petrosal sinus; *4*, the facial nerve; *5*, the acoustic nerve; *6*, the jugular bulb region; *7*, the sigmoid portion of the lateral sinus; *8*, the knee of the lateral sinus; *9*, the lateral sinus; *10*, the basilar plexus of veins; *11*, the course of the inferior petrosal sinus, and *12*, the foramen magnum.

THE SUPERIOR PETROSAL SINUS

The superior petrosal sinus carries blood from the cavernous sinus to the sigmoid portion of the lateral sinus (fig. 4). It begins at the posterior extremity of the cavernous sinus, passes backward, outward

and slightly upward to end in the knee of the lateral sinus. It is lodged in a groove on the posterosuperior margin of the petrous pyramid and lies along the line of separation of the middle and posterior fossas of the skull. It is in close contact with the inferior petrosal sinus at its anterior extremity.

THE INFERIOR PETROSAL SINUS

The inferior petrosal sinus conveys blood from the cavernous system to the jugular bulb (fig. 4). It is shorter and wider than the superior petrosal sinus. It has its origin at the posterior extremity of the cavernous sinus and inclines markedly downward to terminate in the jugular bulb or internal jugular vein. It lies in the petro-occipital suture, which is the groove formed by the junction of the lower margin of the petrous pyramid and the basilar process of the occipital bone.

Before entering the cavernous sinus, where it is in close proximity with the superior petrosal sinus, it passes with the abducens nerve through Dorello's canal (fig. 3). As has been pointed out, the two petrosal sinuses are in close contact with one another at their anterior extremities, where they enter the cavernous sinus together. Any circulatory changes in one will materially affect the circulation of the other. The presence of an obturating thrombus in the knee of the lateral sinus will throw the burden of carrying the blood from the cavernous system to the unobstructed portion of the lateral sinus on the inferior petrosal sinus. This will produce congestion in the latter venous channel. On the other hand, the presence of an obturating thrombus in the bulb will cause even greater obstruction to the return flow from the cavernous system. With complete obliteration of the main efferent vessel from one half of the interior of the skull, marked venous stasis and congestion must follow.

This same state of affairs obtains when the thrombus has extended into the petrosal sinuses, but an important difference is to be noted. When the thrombus is located in the lateral sinus, there occurs the passive edema incidental to venous congestion, with some dilatation of the petrosal vessels. However, when the thrombus extends into the petrosal sinuses, the edema of the surrounding dura becomes greatly intensified and spreads to involve a greater area. This is due not only to the obstruction of the circulation, but also, what is more important, to the edema and swelling of the tissues occasioned by the phlebitis and periphlebitis which accompany the pathologic changes within the petrosal sinuses. It is this reaction of the dura along the course of the sixth nerves which is responsible for their involvement. Whether one or both nerves will be implicated depends primarily on the extent of the thrombotic process in the petrosal sinuses. In cases in which the

thrombosis has extended well into the petrosal vessels the reaction of the tissues is apt to be greater and more widespread, so that one or both nerves may become affected. With such an advanced process as was demonstrated at operation in the cases reported in this paper, e. g., a well organized thrombus extending from the torcular herophili through the entire lateral sinus, the jugular bulb and the internal jugular vein down to the clavicle, one is justified in concluding that the thrombus must have also extended into both petrosal sinuses. The absence of bleeding after the removal of the coagula from the interior of the lateral sinus tends to confirm this opinion. Thus, with such a long-standing process as this evidently was, the edema that resulted from the complete blockage of the cavernous system on the diseased side being supplemented by the edema which occurred incidental to the phlebitis and periphlebitis of both petrosal sinuses, the dura in the entire area must have shared in the inflammatory reaction. As has been pointed out, the close proximity of both abducens nerves to the affected area was responsible for the bilateral involvement. Eagleton [5b] is also of the opinion that bilateral involvement in cases of this kind is best explained on the basis of venous stasis and is not the result of active inflammation at the site of the nerve trunks.

As to why the thrombotic process stopped short of the cavernous sinus in this case I am not prepared to say. Perhaps timely operative intervention was responsible for cessation of the thrombosis.

REPORT OF CASE

E. K., a girl, aged 18, was referred to me on Feb. 2, 1933, the chief complaints being otorrhea of four weeks' duration and headaches. The previous personal history was irrelevant.

History of Present Illness.—About four weeks prior to examination the patient had a severe attack of influenza. On the third day of the illness she complained of pain in the right ear. The following morning she was seen by an otologist, and the membrane of the drum was incised. Relief was obtained shortly after, and at the end of the week her temperature was normal; she had apparently recovered fully from the influenza. She remained under the care of her physician for the next two weeks.

During this period her temperature never rose above 100 F., and except for the annoyance of the aural discharge and the inconvenience occasioned by the frequent cleansing of the canal, she experienced no discomfort. During the fourth week of the otitis she began to suffer from headache, which became most severe in the late afternoon and evening. It grew in intensity so that by the end of the fourth week it seemed to be of great concern not only to the patient but to her family as well. She suffered from anorexia, was weak and lethargic and wanted to remain in bed for the greater part of the day. At no time during the otitis did her temperature rise above 101 F.

Otologic examination, made on February 2, revealed a thick, copious discharge from the middle ear. The drum was edematous, and there were definite changes

in the canal. No tenderness of the mastoid could be elicited, however. A whispered voice was heard *ad concham*. The temperature by rectum was 99 F. Because of these findings I urged operation.

The patient was admitted to the Beth Moses Hospital the same morning. Roentgenograms of the mastoids disclosed normal structures on the left side and general haziness on the right. The bone on the right side showed evidence of softening. General physical examination gave negative findings. The urine showed a slight trace of albumin and an occasional white blood cell. The blood findings were 74 per cent hemoglobin, 3,500,000 red cells and 8,860 white cells, with 78 per cent polymorphonuclears.

Mastoid Operation (February 2, 8 p. m.).—The cortex of the mastoid process was hard and extremely thick. The body was essentially pneumatic. The cells were completely coalesced, especially in the tip and zygoma. Free pus was present in the locations mentioned. Far back over the lateral sinus I uncovered a large abscess in which the sinus formed the inner boundary of the cavity. The wall of the sinus was markedly thickened and was covered by an abundance of granulations. I attempted to reach the normal sinus below by removing the plate well down to the tip, but was unable to do so. I followed the sinus backward well beyond the knee, but failed to reach anything that looked like normal wall.

Because of the absence of hyperpyrexia and chills and the high hemoglobin content I thought that there was no indication to proceed further. I had uncovered a considerable portion of sinus, thereby establishing ample drainage. I packed the wound and left it widely open. The day following the operation the temperature rose to 101 F. only. The patient complained of no disorder and seemed fairly comfortable. The second postoperative day was uneventful except for a rise in temperature in the afternoon to 103 F. On the third postoperative day the patient complained of diplopia, and examination disclosed palsy of the right external rectus. The diplopia increased in the direction of the affected muscle. On February 6 the patient had a chill, and her temperature rose to 104 F. A blood culture was taken when the temperature was at its height. The same day the patient noted diplopia when looking to the left. Examination revealed paralysis of the left external rectus muscle in addition to that of the right.

Ophthalmologic Examination (February 6).—The right eye showed defective movement outward. Lateral excursion of the eyeball was slightly beyond the prime position. The left eye did not move beyond the median line. The other muscles of the eye were not involved. The pupils were equal and regular and reacted to light.

Examination of the fundus showed that both disks were swollen to about 2 diopters. The arteries were narrow, and the veins were dilated and tortuous. There were several flame-shaped hemorrhages in the superficial retinal layers around both disks. No exudate was visible.

A diagnosis of bilateral paralysis of the abducens and bilateral papilledema was made.

I asked Dr. Friesner to see the patient; he was of the opinion that the case was one of thrombosis of the lateral sinus. This was confirmed the next morning when the blood culture which was taken the previous day was reported positive. Streptococcus haemolyticus appeared on all the plates and on the flask. This left little speculation as to the diagnosis, and the patient was ordered to the operating room.

Operation (February 7, 8 p. m.).—Resection of the internal jugular vein and exploration of the lateral sinus were performed.

The neck contained many glands. They were matted together in one large mass extending from the angle of the jaw one-half the distance to the clavicle. A large portion of these had to be incised before one could see the sheath of the carotid artery. The latter was opened. The internal jugular vein was markedly thickened and discolored and was enlarged to the size of one's index finger. It was completely thrombosed. I followed it down to a point just within the clavicle, where the thrombus ended. Here one could see a normal venous wall with normal pulsations. I ligated the vessel below the thrombus and dissected the vein upward as far as the angle of the jaw. I placed another ligature here and removed the portion of the vessel between the ligatures. The wound in the neck was closed, and a rubber drain was inserted.

Proceeding to the sinus, I made a long Whiting incision and uncovered the lateral sinus back to the torcular herophili, at which point some normal wall was visible. The entire lateral sinus, from the torcular herophili to the bulb stood out in relief against the surrounding tissues. It was a striking demonstration of how completely this large venous channel in the cranium could be blocked off from the circulation in nature's effort to wall off a threatened invasion of the general blood stream. One is struck by the fact that, despite such an extensive pathologic condition in the head, which must have existed, for the most part, prior to the operation on the mastoid, the patient was ambulatory and gave little external evidence of its presence.

Without packing off the sinus, I made an incision in the latter from the torcular herophili to the bulb, with one long sweep of the knife. The outer wall of the sinus was more than an eighth of an inch (0.3 cm.) in thickness. No bleeding followed the incision. At will I removed well organized clots from the interior of the sinus. In one part I found free pus in the lumen of the sinus. I excised a goodly portion of the wall of the sinus and introduced a drain of iodoform gauze into the bulbar end. No free bleeding occurred during the entire procedure. The wound was packed, and a firm dressing was applied. The operation required in all two hours and forty minutes. The patient left the operating room in exceptionally good condition. The hemoglobin content was 70 per cent, and the patient received no transfusion following the operation. However, a hypodermoclysis of 350 cc. of a 5 per cent solution of dextrose was given.

Postoperative Course.—On February 8, 9 and 10 the course was uneventful. The temperature rose to 104 F. on the day after the operation, but on the two following days the maximum elevation was 102 F. There was no recurrence of chills or of chilly sensations. There was a moderate headache, which was readily controlled with codeine. Diplopia was present and was very annoying to the patient. A blood culture taken on February 10 was subsequently reported negative.

On February 11 the temperature reached normal in the morning and rose to only 101 F. in the evening. The dressing was changed under ethylene-oxygen anesthesia. The wound in the neck was clean, and primary union was evident. Removal of the packing from the sinus was not followed by bleeding. The drain in the bulbar end was withdrawn, and this was followed by a free flow of pus, which welled up and pulsated. Another drain was inserted, and the wound was packed.

The period from February 12 to February 21 was uneventful. The temperature ranged between 99 and 101 F. The patient's general condition improved; her appetite was good, and she gained weight. Diplopia was still present, but the external rectus muscles began to show signs of regained function.

Ophthalmologic examination on February 21 showed marked improvement of function in both external recti. Both eyeballs moved laterally midway between

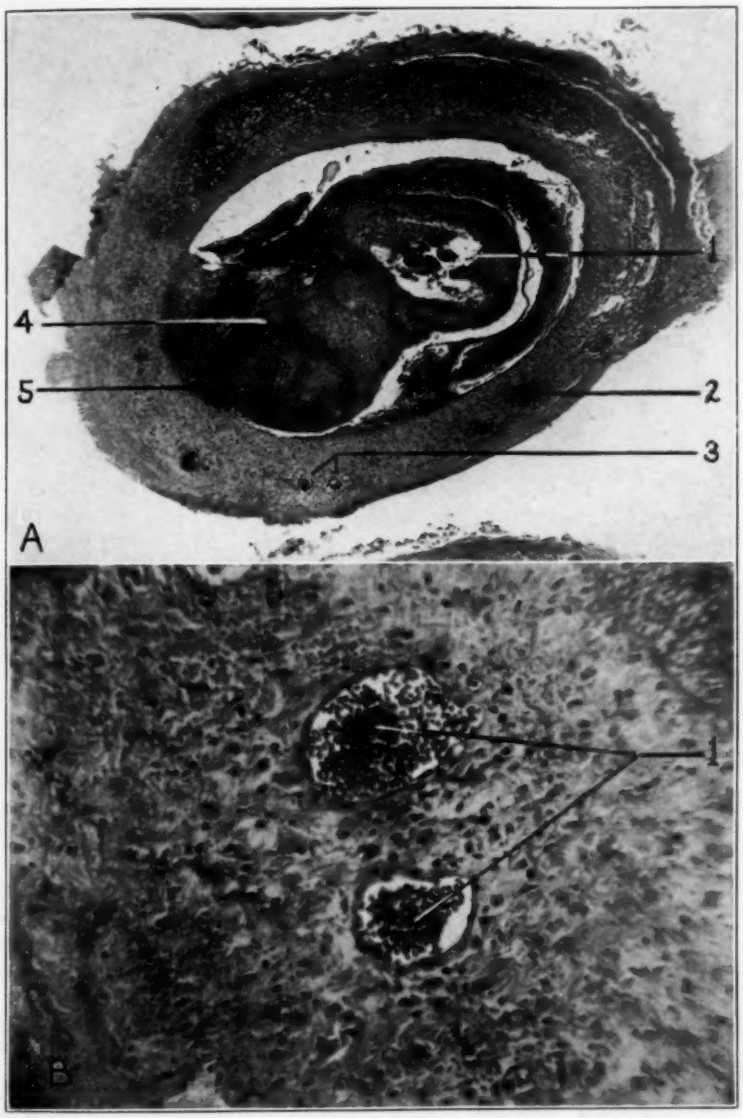

Fig. 5.—Section of the resected jugular vein under low power lens (*A*) and high power lens (*B*). *1* indicates the broken-down thrombus in the center of the coagulum; *2*, the thickened venous wall; *3*, the newly formed blood vessels in the venous wall; *4*, the dense thrombus in the interior of the vein, and *5*, the place of attachment of the thrombus to the venous wall.

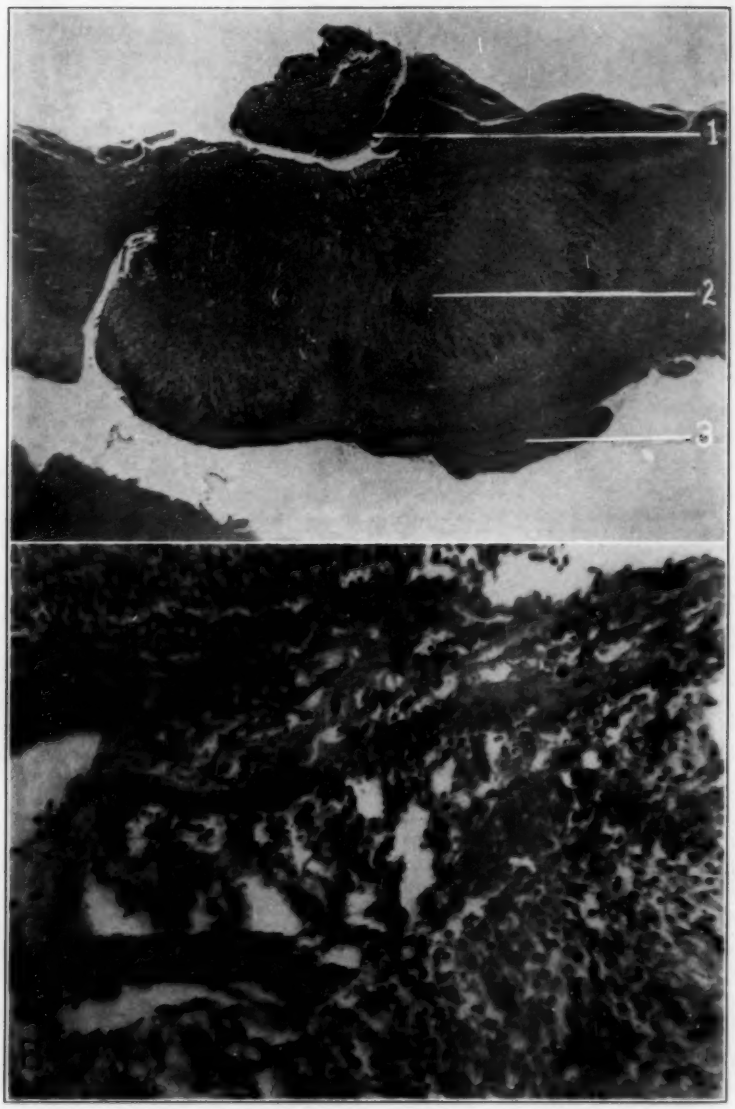

Fig. 6.—Section of the diseased lateral sinus under low power lens (*A*) and high power lens (*B*). *1* indicates the thrombus adherent to the wall of the sinus; *2*, the marked hyperplasia and thickening of the wall, and *3*, granulations on the external surface of the sinus.

prime position and external lateral rotation. On examination of the fundi the outline of the left disk could easily be made out, and that of the right was beginning to return. No hemorrhages were noted in the left fundus; a few were visible in the right.

On February 22, under ethylene-oxygen anesthesia, the edges of the wound were freed and undermined. Several silkworm gut sutures brought the wound together, thereby materially diminishing the granulating surface. The wound in the neck was completely healed.

From then on convalescence was uneventful. The patient was out of bed on March 9 and was discharged on March 12, after a stay of six weeks in the hospital. At this time diplopia was still present. She continued treatment at my office until April 4, when she was discharged as cured. The wounds of the neck and mastoid were firmly healed. The middle ear was dry, and hearing was practically normal. The external recti functioned normally, and the diplopia was gone.

PATHOLOGIC REPORT

The specimens examined were the jugular vein and a section of the wall of the lateral sinus.

Gross Appearance.—The first specimen consisted of a section of the jugular vein measuring 6 cm. in length and 9 mm. in diameter. A small blood clot, 4 mm. in length, protruded from one end. A cross-section revealed a thickening of the venous wall, with a number of punctate hemorrhages scattered throughout all the coats. The lumen was occluded by a recent thrombus adherent to the wall.

Two pieces of tissue from the lateral wall of the sinus were also examined.

Microscopic Appearance.—The wall of the jugular vein presented numerous scars composed of recent granulation tissue with newly formed capillaries. A collection of polymorphonuclear leukocytes were also found. The intima was adherent to a blood clot, with necrotic tissue, fibrin and leukocytes in the process of organization. In one section only was purulent material present in the lumen of the vein. Stains revealed numerous gram-positive cocci in the intima and clot.

The lateral sinus revealed changes of an older nature. The adventitial tissue and perisinusoidal areolar tissue revealed granulation of a stage older than that in the jugular vein. The tissue was edematous, and the cellular infiltration contained plasma cells, leukocytes and swollen histiocytes. There were also perivascular collections of these cells. The wall of the sinus was scarred, and the intima showed thickening with adherent organized thrombotic material which contained fibrin and leukocytes. Gram-positive cocci were present in all the coats of the sinus.

Diagnosis.—The condition was diagnosed as acute purulent thrombophlebitis of the jugular vein and of the lateral sinus.

169 New York Avenue.

DENTIGEROUS CYSTS OF THE ANTRUM

REPORT OF TWO CASES

ANDREW A. LOVE, D.D.S., M.D.
LOS ANGELES

Dentigerous cysts are one type of a group of benign central tumors of the jaws arising from the anlagen of the teeth. These tumors are, of course, of epithelial origin and are called the odontomas. They may form from the enamel organ of an unerupted tooth, but the majority have been believed to develop from the paradental rests (cords of Malassez). Included in this group of tumors in addition to dentigerous cysts are the hard odontomas—sharply circumscribed, hard tumors composed chiefly of dentin with a little enamel—and the adamantinomas—soft tumors composed of epithelium growing in masses or cords closely resembling embryonic enamel organs. The hard odontomas and dentigerous cysts grow by direct expansion, and the adamantinomas grow by expansion and infiltration. None of them metastasize.

INCIDENCE

Dentigerous cysts have been found in the orbit, the hard palate and the upper and lower jaws, and in general they all conform to the same gross and microscopic structure.

They have been known to be bilateral or multiple, as many as four having been observed in the jaws of the same patient concurrently. They are found in the lower jaw about twice as frequently as in the upper. In Bloodgood's series of thirty-two cases at the Johns Hopkins Hospital up to 1930, fourteen were in the upper jaw.

Dentigerous cysts of the antrum have been recorded in persons from 6 to 60 years of age, but they usually appear between the first and third decades of life. This is the normal time for the eruption of the teeth usually included in the cyst. The vast majority develop in connection with the permanent teeth, only four having been reported in connection with the deciduous set. Supernumerary and malformed teeth have been seen in these cysts, but as a rule the crown at least is well formed. The cuspids and the third molars are most frequent, although all of the upper teeth have been discovered in these cysts.

Typical dentigerous cysts have been found in horses, cattle, sheep, pigs and porcupines. In this paper, however, only those occurring in the human antrum will be discussed.

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REVIEW OF THE LITERATURE

In the study of any comparatively rare disease it is always interesting to note the accuracy with which the early physicians recognized, described and treated it.

In 1855, Hancock [1] quite accurately described the gross pathologic appearance of a dentigerous cyst of the maxilla as, "Consisting of a single bony cyst lined by a membrane, with a second canine tooth adherent to it, and having its cavity filled with a glairy fluid."

In 1856, Nelaton [2] described a tumor in the right maxilla of a 16 year old girl, "which bulged out the wall of the canine fossa about the size of a pidgeon's egg and did not extend into the nose. The wall was somewhat compressible and had the crackling sound of dry parchment when palpated." He made a wide opening in the right maxilla and removed the tumor in toto. He said:

> It was surrounded by a bony shell and lined with thickened membrane containing small, broken-down granules. There was a canine tooth in the cyst; the crown in the cavity and the root were continuous with the dental cords, i. e., the gubernaculum dentis. The shell was independent of the maxillary sinus, and it had pushed the wall of the antrum, which was very thin anteriorly, outward.

Thus he outlined the picture of a typical dentigerous cyst of the antrum, and his ideas in regard to its histogenesis were surprisingly correct.

In 1870 Thomas Bryant [3a] wrote his "Comments on Cystic Disease of the Antrum," and reported the case of a 6 year old boy who presented:

> A swelling of the left cheek, more particularly toward the nose. There was a bulging of the palatal process of the maxillary bone into the mouth but no encroachment into the nasal cavity. Under chloroform anesthesia a free opening was made in the antrum. Some serous fluid escaped and on careful examination the glistening surface of a lateral incisor tooth was seen projecting from the nasal angle of the cavity and growing obliquely upward.

In 1874 the same author [4] reported a dentigerous cyst in a 12 year old girl, connected with an upper right canine tooth.

In 1883 Stokes [5] reported the case of a 20 year old youth who was suffering from a large tumor on the left side of the face. "It was pain-

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less and, except for the disfigurement, was no source of annoyance. On examination the tumor was found to be slightly fluctuant and a crackling sensation like that of dry parchment was distinctly felt. It had grown of late." At operation he removed a large molar from within the tumor, and a considerable amount of amber-colored fluid escaped. He removed a portion of the wall of the cyst and packed it with strips of lint. One month later the patient went home, the deformity having disappeared.

Berger[6] (1889) reported a case in a 13 year old girl in whom there was:

> A swelling of the jaw and canine fossa and into the palate which had started two and a half years before examination. It had grown slowly until just a few weeks before admittance. All the teeth were in place except the upper left central and lateral incisors, which were irregular and loose. The canine fossa was opened. The wall was found to be cartilaginous, covered by mucosa on the outside and lined with smooth membrane inside. There was a thick gelatinous liquid contained in it. On palpation through the opening, the cavity was found to extend past the median line of the nose, back to the palatine arch, which was destroyed, just the mucosa being left beneath. On the floor was the crown of an incisor tooth.

Berger took the tooth out and packed and irrigated the cavity until it filled in.

Other cases were reported up to the beginning of the twentieth century, but these and the work of Dupuytren,[7] Delpech,[8] Broca,[9] Magitot,[10] Robin,[11] Wedl[12] and Malassez[13] were the most notable. Since then Guthrie,[14] Cobb,[15] Bloodgood,[16] Partsch, New,[18] Frank,[19] Dorrance,[20]

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10. Magitot: Arch. gén. de méd. **2**:339, 1872.
11. Robin: Compt. rend. Soc. de biol. **4**:199, 1867.
12. Wedl, Carl: Pathologie der Zähne, Leipzig, A. Felix, 1870, p. 362.
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16. Bloodgood, J. C., in Lewis, Dean: Practice of Surgery, Hagerstown, Md., W. F. Prior Company, Inc., 1930, vol. 4, chap. 4, p. 247.
17. Deleted by author.
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19. Frank, I.: Report of Case of Dentigerous Cyst, Ann. Otol., Rhin. & Laryng. **26**:991 (Dec.) 1917.
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Bland-Sutton,[21] Scudder,[22] Witham,[23] Ewing[24] and Goodyear[25] have contributed greatly to the knowledge of the etiology and treatment of this condition.

GROSS PATHOLOGIC APPEARANCE

As a rule it is not until the cyst has forced the walls of the antrum anteriorly or into the palate or the nasal passage that the patient presents himself for treatment. The upper jaw expands considerably before there is destruction or perforation. The slow growth of the cysts is not as a rule attended with pain, and the majority are not infected until late, if at all. The examination shows a rounded swelling of the face in the region of the canine fossa, and in neglected cases the tumor involves the whole half of the upper part of the face. The mucous membrane of the oral and nasal cavities is intact unless infection has been present for some time, and then a fistula is present which usually empties into the mouth. On exploring the cyst through the canine fossa, there is found a thin bony shell entirely surrounding the soft tissue of the cyst which can easily be stripped away from the walls of the antrum. The soft tissue lining of the cyst is also easily separated from the bony shell except in infected cases, when it is firmly adherent to it, fibrosis and granulation tissue being present. Calcification may take place in the walls of the cyst.

The contents of the cyst, besides a fully formed or partially developed tooth or teeth, consist of a thin straw-colored fluid or a clear or bloody gelatinous fluid which usually contains cholesterol crystals. If the cyst is infected, there may be pus, and in some the contents may consist of a thick material which will be found to be made up of degenerated epithelial cells and cholesterol crystals.

According to the stage of the development of the tooth in connection with which the cyst forms, there will be found the whole or part of a tooth. The crown of the tooth is usually looking toward the interior of the cyst, the soft tissue of the wall being attached to the gingival border of the crown, and the root, if there is one, may or may not be embedded in the alveolar process or adjacent bone. There may be more than one tooth, but as a rule when the cyst is unilocular there is but

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22. Scudder, C. L.: Tumors of the Jaws, Philadelphia, W. B. Saunders Company, 1912.

23. Witham, J. D.: Tumors of the Jaw from the Standpoint of the Rhinologist, Ann. Otol., Rhin. & Laryng. **32**:474 (June) 1923.

24. Ewing, James: Neoplastic Diseases, ed. 2, Philadelphia, W. B. Saunders Company, 1922.

25. Goodyear, H. M.: Follicular Dental Cyst, Laryngoscope **38**:328 (May) 1928.

one tooth. Multilocular dentigerous cysts do occur, two of the fourteen in Bloodgood's series found in the upper jaw being of this type. The tooth may occupy any position in the cyst. It may be concealed in the wall and covered by living membrane; it may lie free in the cavity; it may be upright in a natural position, or it may lie crooked in an unusual position.

Unlike other cysts associated with new growths, the development of the dentigerous cyst advances along with a new growth of bone in its wall, so that the bony wall is not a mere expansion of a previously existing bony capsule with subsequent pressure atrophy and thinning of the wall, but the shell of the bone is formed over the advancing, expanding tumor.

ETIOLOGY

The fact that certain cystic and dentigerous tumors of the maxillae are of dental origin has been known for more than a century, but until the middle of the nineteenth century the structural details and histogenesis were not well studied. At this time it was generally supposed that all the cystic tumors arose from dilated dental follicles. In 1856 Nelaton [2] appreciated the fact that they arose from the follicle of a tooth, and he questioned, "whether there was multiple dentition in some alveolus or whether the alveolus was enlarged by the development of its contents so as to constitute itself the bony shell with the opening below, where is found the tumor." Others, such as Barnes, Delpech,[8] Forget and Dupuytren,[7] held similar views. In 1868 Broca systematically classified all the odontomas. In 1870 Thomas Bryant [3a] stated:

> There is little doubt that many of the cystic tumors of the antrum are connected with irregular dentition.
>
> How many is not yet positively determined, for although it is well known that cysts of the antrum are constantly found to contain or perhaps to originate about some tooth which is taking an abnormal direction, pathologists have not yet determined how many cysts or tumors depend on such a cause.

In 1872 Magitot [10] classified the odontomas on the hypothesis that all originate from the follicle of a tooth, excluding certain cysts which he thought developed between the periosteum and the tooth.

The entire subject was greatly simplified by the brilliant work of Malassez [13] in 1885, in which he referred to their origin in the embryonal remnants of the enamel organ, which he termed the *débris épithéliaux dentaires*. These are in all probability vestigial remains of the enamel organs of the more abundant dentition of the lower vertebrates. They are found in large numbers in the paradental membrane, and are small collections of epithelial cells found (1) just underneath the gingival mucous membrane and (2) scattered along the borders of the teeth from the apex to the gingival border. Malassez thought that they were

derived from three sources: (1) from the mucous membrane of the fetal jaw, (2) from the epithelial cord and lamina between the mucous membrane and the enamel organ and (3) from the outer epithelial membrane of the enamel organ itself about the root of the tooth.

In 1890 Hektoen [26] said:

> Unilocular dentigerous cysts resulting from the matrix of a temporary or permanent tooth failing to find its way to the alveolar border of the jaw, and the cells of which matrix have subsequently undertaken the completion of their inherited capacity, viz.: the formation of a perfect tooth, with the various pathologic conditions possible to result from even a typical cell-proliferation in this abnormal situation.
>
> Such a cyst is not necessarily a true tumor but may be simply a retention of fluid between the cuticular dentis and the crown of the tooth, distending the tooth follicle into a cyst lined with epithelium, and containing in the part of its wall, or more rarely, free in its cavity, a more or less completely developed tooth, or even teeth.

In 1895 Jay [27] made some interesting observations on the etiology and pathology of these cysts. He said:

> Cyst formation resulting from the displaced matrix of a tooth is of scientific interest because of its bearing upon Cohnheim's theory of tumor formation by cell proliferation from a matrix of embryonal cells. In the case of a dentigerous cyst there is an inclusion in the mesoblastic bone of the epithelial cells of the tooth matrix, which cells at some subsequent period undergo proliferation that may be typical or atypical and productive of a neoplasm that is almost in every instance a cyst. In the production of a dentigerous cyst, however, there is no necessity for the presence of the matrix of embryonal cells insisted upon by Cohnheim as being essential in the production of a real tumor. The cells may be typical in every respect, and are productive of a cyst because they are compelled to carry out their life history in an abnormal situation, with retention of fluid in the cavity produced during the attempt at tooth formation. In the dentigerous cyst from an included tooth matrix, the progressive enlargement is due to tension as the contents of the cyst increase.

In 1921 Dorrance [20] thought that dentigerous cysts develop from the enamel sac which surrounds an unerupted or supernumerary tooth, which develops hypertrophy and proliferation at the time the tooth should be erupting. This seems to coincide fairly well with the modern trend of thought.

Hajek [28] believed that "follicular maxillary cysts (dentigerous cysts) originated in retained or supernumerary isolated tooth germs and are

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26. Hektoen, L.: Maxillary Cysts Connected with the Teeth, Cook County Hosp. Rep. **1**:35, 1890.

27. Jay, F. W.: Cysts of the Maxilla Connected with Teeth: Case Report, M. News **66**:368, 1895.

28. Hajek, M.: Pathology and Treatment of the Inflammatory Diseases of the Nasal Accessory Sinuses, translated by J. D. Heitger and F. Hansel, St. Louis, C. V. Mosby Company, 1926, p. 182.

much more infrequent than those developing from granulomata, and that they develop from root granulomata." Their genesis from the tooth roots he thought evident from the presence of one or several teeth projecting into the cavity with their roots embedded in the wall of the cyst.

Scudder [22] expressed the belief that the theory of Malassez, i. e., that all odontomas develop from the paradental rests, holds true in regard to the dentigerous cysts. He quoted the case of Barrie in the lower jaw, histologic examination of which (Bloodgood) showed "that the cyst is lined with distinct adamantine epithelium." He argued that, "Consequently, this dentigerous cyst has the same origin as the adamantine epithelium, viz., from the epithelial paradental rests." He thought that Barrie's case established on a fairly firm basis the etiology of the dentigerous cysts according to Malassez' theory. He concluded, however, with the statement that "Whether the cyst forms because of a disturbance in the development of the normally placed tooth-follicle (Broca), or whether it is due to a misplaced paradental rest developing (Malassez), is difficult to decide. Both views are possible."

Ewing [24] expressed the belief that the cyst is probably formed from the dilated gubernaculum or follicle.

Dean Lewis, writing in 1910, commented, "It is odd that they (dentigerous cysts) tend to benignancy although composed of misplaced epithelium. It is difficult to see how such complicated growths as these can develop from ingrowths of ordinary buccal membrane. The ordinary squamous carcinomas are much more apt to form on such a base." This fact I believe is one of the strongest talking points against their origin from the paradental rests of Malassez.

Thus it is seen that the exact etiology has been a matter of a great amount of study and conjecture. In explaining it there are four distinct portions of the structure to be accounted for: (1) An independent, thin, outer shell, stripping easily from its external confines (in the absence of infection) and also from the soft tissue layer just central to it. (2) A soft tissue layer lining the cyst composed of fibrous connective tissue and an inner lining of epithelium. In this layer are at times found thin calcified layers. The epithelium is described by some as being squamous, by some as stratified, by some as cuboidal and by others as adamantine. In no case is the epithelium ciliated. (3) The presence of the crown of a tooth, usually well formed and sometimes almost or entirely buried. In typical cysts the entire crown is included in the cavity, the soft tissue lining being adherent to the neck of the tooth in the normal gingival line. (4) The fluid contents of the cyst, usually a thin, straw-colored fluid containing cholesterol. If the cyst is infected or has been infected, a thick purulosanguineous or even a caseous substance is contained in it.

To conceive of a hard odontoma consisting of dentin and enamel arranged in a heterogeneous manner, forming at times grotesque dental forms developed from the epithelial débris of Malassez, seems possible and even probable. Likewise, the adamantinoma, cystic or otherwise, consisting of groups or cords of epithelial cells resembles embryonic enamel organs. But that an entirely benign dentigerous cyst having a fairly constant structure, with or without intermediary infection, can be formed from a small group of epithelial cells of no constant microscopic arrangement or anatomic distribution, found in large numbers in the paradental membrane in both child and adult, does not seem rational from a pathologic point of view. If it were, why does the included tooth form normally as a rule, and from what do the walls develop?

I have not been able to find the record of a study of a case of dentigerous cyst which did not fill the entire antrum. A histologic study of such a case would undoubtedly cast light on many unsolved points, especially the formation of the outer bony shell.

Two patients with dentigerous cysts, one infected and one not infected, were operated on during the past two years at the Los Angeles County General Hospital, and it is on a clinical and pathologic study of these that the present paper is based. They are as follows:

REPORT OF CASES

CASE 1.—*Clinical History.*—W. F., a 13 year old boy, had a painless swelling of the right maxilla which he said had been increasing in size for the past three months. There was no history of frequent colds, a nasal discharge or trauma.

Physical Examination.—There was a firm, uniformly round swelling in the right maxillary region extending from the canine fossa to the tuberosity and from the alveolar border to the infra-orbital ridge, causing considerable external deformity. There was no fluctuation, and only mild discomfort on pressure. The teeth of the upper jaw were free from caries, and fourteen were present in a well formed dental arch. Examination of the nose showed the right lateral nasal wall to be pushed medially, the middle turbinal being in firm contact with the septum, which was not deviated. The temperature and pulse rate were normal. Roentgenograms showed the right antrum to be opaque, with almost complete absence of the lateral wall and the adjacent portion of the alveolar arch. The crown of a tooth was visible in the upper portion of the right medial wall (fig. 1). The other sinuses were negative roentgenographically. A diagnosis of probable dentigerous cyst was made, and the patient was admitted to the hospital for surgical intervention.

Operative Findings.—On maknig the usual vertical incision in the region of the canine fossa, the soft tissues were found to be very thin, and the wall of the cyst was intimately adherent to them. The outside layer of the wall of the cyst was composed of a calcified layer about the thickness and consistency of egg-shell, and this layer extended the entire circumference of the cyst. The cyst was filled with a straw-colored, moderately turbid fluid, the culture from which showed both staphylococci and hemolytic streptococci. There was an undeveloped upper third molar attached to the medial wall of the antrum in the region of the natural ostium,

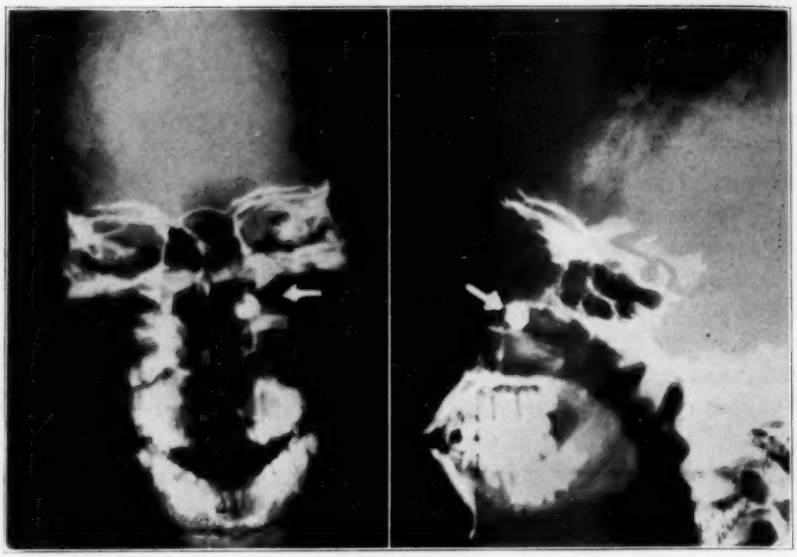

Fig. 1 (case 1).—Anteroposterior and lateral roentgenograms allocating the crown of the upper right third molar. Owing to the age of the patient, the roots were not as yet developed. (The cyst in this case was not infected.)

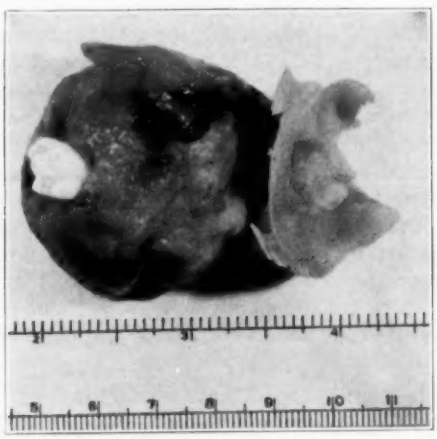

Fig. 2 (case 1).—The entire cyst after removal and fixation in formaldehyde. It is turned inside out to show the crown of the tooth and is smaller than normal owing to its fixation. A large piece of the shell is laid against the cyst.

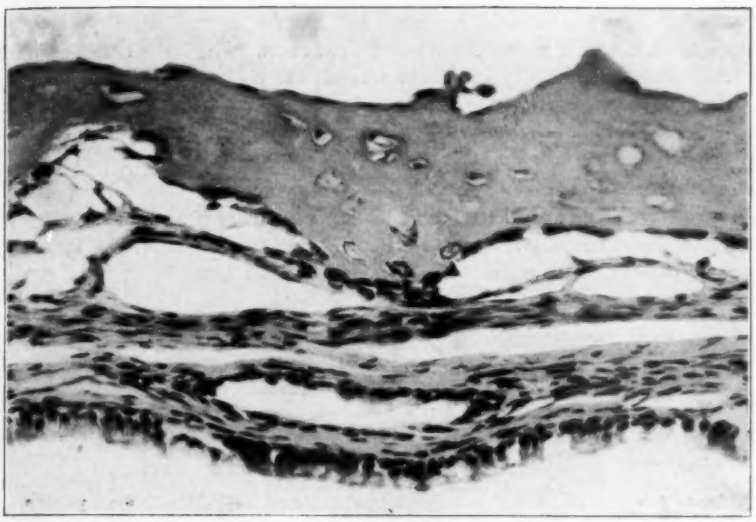

Fig. 3 (case 1).—Section of the bony shell surrounding the cyst. Note the pseudostratified, columnar, epithelial lining and the bony outer portion.

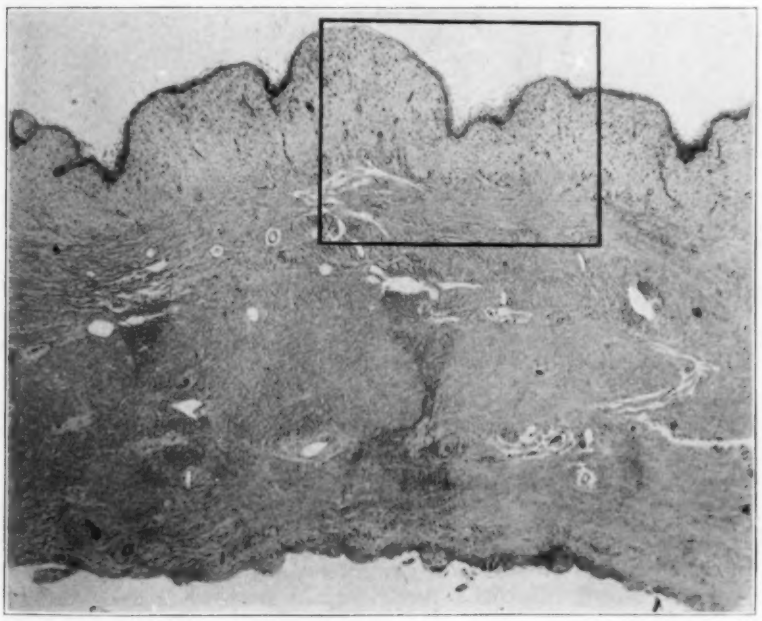

Fig. 4 (case 1).—Section through the inner wall of the cyst. The area in the inset is shown under high power view in figure 5.

its crown facing inward. There were no roots on the tooth because of the age of the patient. The antrum was much larger than its normal size, and the entire cavity was lined with a membrane about 2 mm. thick. The lateral wall of the nose had been forced intranasally and there was almost no bony structure in the nasal wall. A complete exenteration of the entire cyst was made, and it was removed in one piece (fig. 2). A large naso-antral opening was made under the inferior turbinate. The incision was sutured.

Postoperative Course.—The convalescence was uneventful, and the patient was discharged from the hospital four days later. There was moderate drainage intranasally for about ten days. On examination three months later, the facial deformity had entirely disappeared, and the patient said that he had no untoward symptoms.

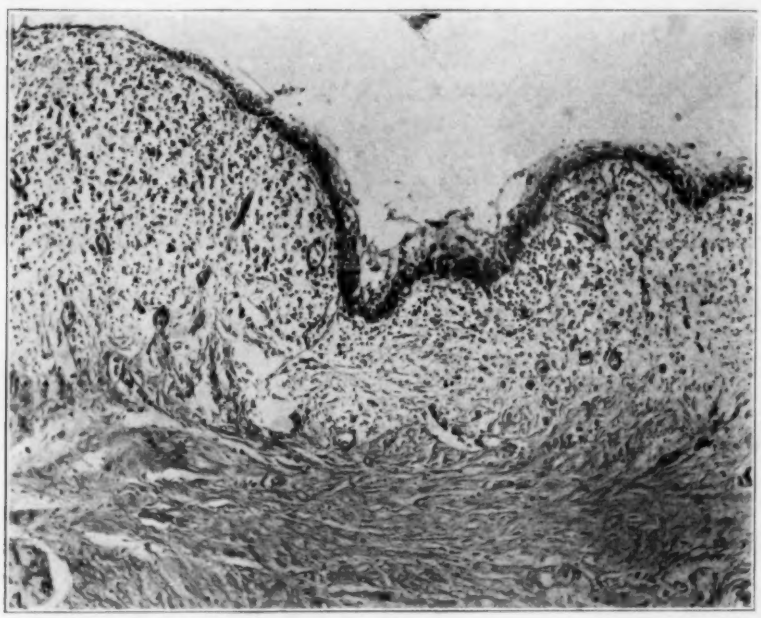

Fig. 5 (case 1).—High power view showing the inner wall of the cyst lined by adamantine epithelium.

Pathologic Report.—The section through the thin outer wall of the cyst showed a thin layer of bone, the outer surface of which was covered by a thin layer of fibrous tissue. This again was lined by pseudostratified columnar epithelium (fig. 3).

The section through the inner wall of the cyst showed it to be lined by adamantine epithelium lying on loose connective tissue in which there were a few blood vessels. Round cells and a few eosinophils and polymorphonuclear leukocytes were scattered throughout. Beneath this there was a layer of moderately dense connective tissue (figs. 4 and 5).

Case 2.—*Clinical History.*—L. A., a woman, aged 23, entered the hospital complaining of a painful area in the upper left second and third molar region. She said that she had no dental trouble until one year before, when the left side of the

upper gum became soft. She had not had pain, however, until four weeks previously, when the gum in that region swelled and became intensely painful and finally "broke"; there had been a discharge of foul-smelling pus ever since. She visited a dentist six days before, who lanced the gum and obtained a large amount of foul-smelling pus and caseous material. She was referred by the dentist to the clinic for diseases of the ears, nose and throat.

Physical Findings.—There was a large fistula just above the upper left second molar leading into the antrum. The discharge from this fistula was foul-smelling. The soft tissues surrounding the fistula were inflamed, swollen and painful to touch. There was no nasal discharge or facial deformity. The teeth on that side were not carious, but the first and second molars were somewhat loose. Roentgenograms showed that all of the sinuses were clear, except the left antrum, which

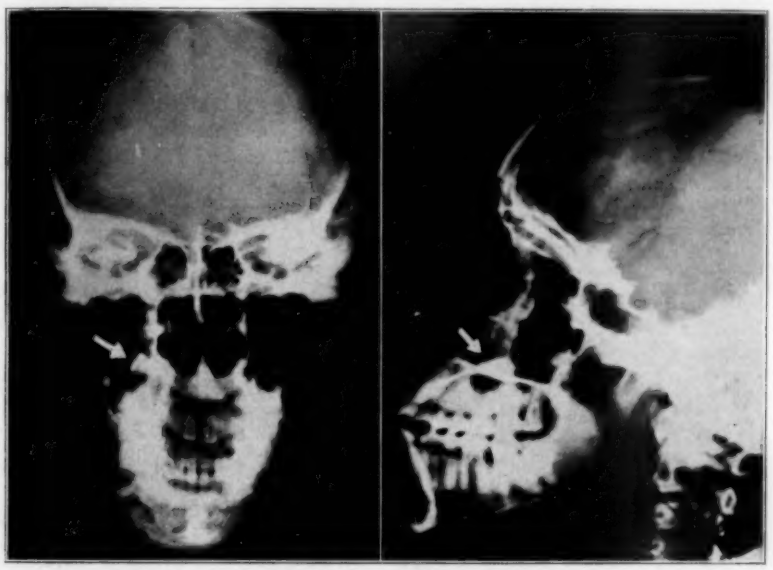

Fig. 6 (case 2).—Anteroposterior and lateral roentgenograms showing the upper left third molar lying on the posterolateral floor of the antrum. (The cyst in this case was infected.)

was opaque. An unerupted left third molar was seen to rest in a region just above the upper second molar, its crown facing outward and posteriorly (fig. 6). A diagnosis of osteomyelitis of the tuberosity of the maxilla and possible dentigerous cyst of the antrum was made, and a Caldwell-Luc operation was undertaken under local anesthesia.

Operative Findings.—The bony plate of the maxilla in the region of the canine fossa was of paper thickness. The entire antrum was filled with a cyst, the walls of which were about 4 mm. thick and composed of dense, tough, fibrous tissue. The wall of the cyst was closely adherent to the sides of the antrum. The crown of the upper left third molar was projected medially into the cyst. There was an opening from the antrum through the buccal plate in the third molar region, the bone in that region being necrotic. The cyst, including the tooth, was removed in its entirety through the usual opening in the canine fossa (fig. 7). The bleeding

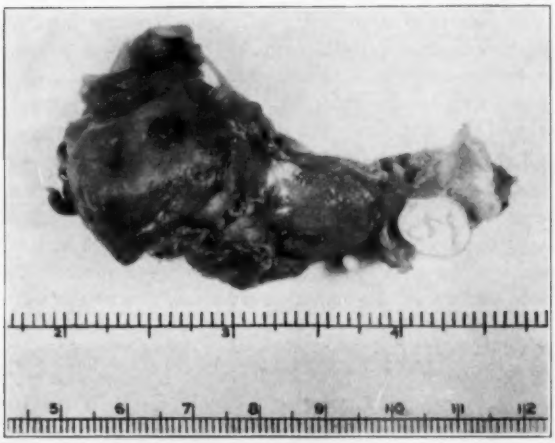

Fig. 7 (case 2).—The entire cyst after removal and fixation in formaldehyde. This cyst was separated from its bony shell and the wall of the antrum with considerable difficulty, owing to fibrous adhesions.

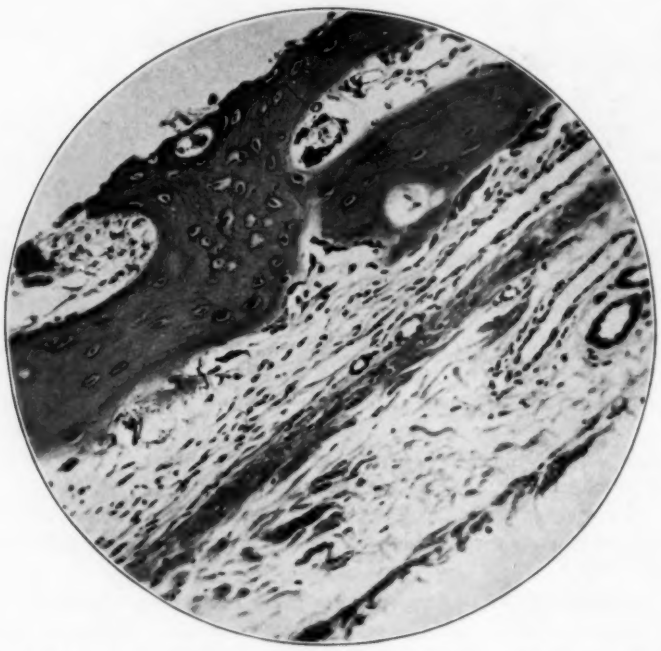

Fig. 8 (case 2).—Section of the bony wall of the cyst (high power view). It was thicker than that in case 1, and in the removal the inner epithelium was destroyed at operation or by the infectious process (probably the latter).

was profuse during the operation, and with the greatest difficulty the cyst was separated from the antral walls. A large naso-antral opening was made under the inferior turbinate, and the incision in the canine fossa was sutured.

Fig. 9 (case 2).—Section through the inner wall of the cyst, showing the inner surface lined by adamantine epithelium. At the periphery there is a laying down of bony tissue. The presence of many polymorphonuclear leukocytes and fibrosis gives evidence of the existing infection.

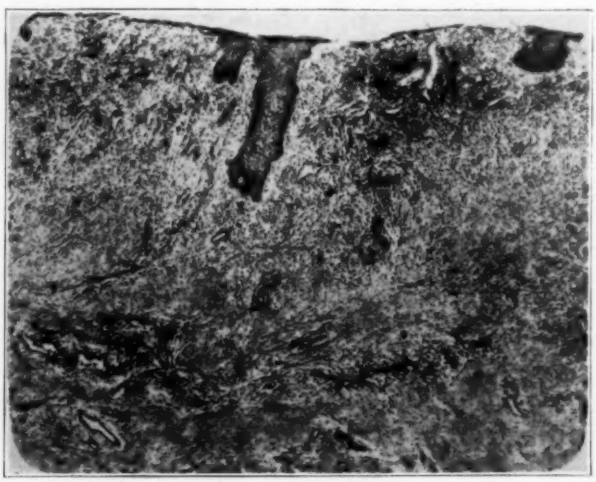

Fig. 10 (case 2).—High power view of the inner surface of the inner wall of the cyst.

Postoperative Course.—There was considerable postoperative swelling of the cheek, with a moderate drainage of thick serosanguineous material from the nose for about one week. The patient was discharged from the hospital eight days after

operation, comparatively comfortable. When seen three months later, the upper jaw appeared normal. She had no nasal discharge and no pain.

Pathologic Report.—The section through the outer wall of the cyst showed a thin layer of bone which was covered by fibrous tissue (fig. 8).

The section through the inner wall of the cyst (figs. 9 and 10) showed it to be lined on its inner surface by adamatine epithelium. In certain areas this was covered by a fibrinous exudate in which were enmeshed red blood cells and polymorphonuclear leukocytes. In other areas the epithelium was denuded. Beneath this there was a fibrous tissue in which there were numerous blood vessels. Throughout this area there was a marked infiltration of polymorphonuclear leukocytes. Toward the periphery of the wall the fibrous tissue became more dense, and there was but slight infiltration of leukocytes and round cells about the blood vessels. At the periphery there was a thin layer of bone which in one small area was covered by fibrous tissue and lined by pseudostratified columnar epithelium.

DIFFERENTIAL DIAGNOSIS

Dentigerous cysts of the antrum must be differentiated from: (1) infectious processes of the upper jaw and antrum, (2) other benign tumors and (3) malignant growths.

Infectious Processes.—Acute Dental Abscess: The patient complains of pain in the region of an acutely infected tooth. There may or may not be swelling of the jaw and soft tissues, but usually the signs of acute inflammation are present. The onset is sudden, and examination of the teeth in the region affected will reveal the cause of the pathologic condition. Roentgen examination confirms the diagnosis, but is not necessary as a rule, especially to one trained in dental diagnosis.

Chronic Dental Abscess: In this condition the patient has moderate or no pain in the region affected, and rarely there are swelling and fluctuation. Clinical examination of the teeth will usually suggest the diagnosis without resort to roentgen examination.

Radicular Cysts: These are most common between the ages of 20 and 30, but may occur at any age. Occasionally they form in connection with the deciduous teeth, but this is uncommon. It is essential that there is death of the pulp with subsequent development of a granuloma; this develops into a cyst because of central degeneration of the granuloma. The pathologic sequence is probably: (1) death of the pulp, (2) development of a granuloma, (3) irritation of the so-called epithelial rests by bacterial or other toxins, which stimulates them to an overgrowth; this goes on until the lining is epithelialized. They are most frequent in the incisor and cuspid region.

The roentgenogram is quite conclusive in these cases, together with the finding of a tooth underneath the cyst that has been devitalized, either mechanically or by disease. When the cyst has grown to any size it will resemble a dentigerous cyst grossly, there being a uniformly

rounded swelling of the jaw without signs of inflammation. There is a history of slow growth and an absence of pain unless the cyst has grown very large. The tooth or teeth in the sockets below the cyst are usually loose. A roentgenogram will disclose an absence of a tooth in the cyst.

Osteomyelitis: In these cases the patient has swelling of the soft tissues overlying the affected area, and there is a history of extraction of a tooth or trauma of some sort, with a sudden onset of pain and swelling. The soft tissues are tender overlying the area, and if of several days' standing, a hard brawny cellulitis with or without localized abscess formation will have resulted. There may be suppuration through the socket of a tooth or into the nose or canine fossa. The history usually gives an accurate clue to the situation, and if the process is at all advanced, the roentgenogram is suggestive.

Maxillary Sinusitis: This condition is so common and its symptoms and findings are so well known that there rarely should be any difficulty in the differential diagnosis. In acute or chronic sinusitis there is rarely any swelling of the overlying tissues. There must have been a mechanical egress of infection through the anterior wall of the antrum in order to have any degree of swelling.

Other Benign Tumors.—Hard Odontoma: These are slowly growing tumors of dental origin which produce a deformity in the region of the canine fossa without pain, unless far advanced. They are extremely hard and immobile and show a sharply circumscribed outline in the roentgenogram. Their extreme hardness and the lack of evidence of metastasis and slow growth, together with the roentgen findings, will usually give a correct clue.

Adamantinoma: These are slowly growing soft tumors producing deformity without signs of inflammation. They do not metastasize. Roentgen examination may give a suggestion as to the disease, but biopsy alone will make the diagnosis conclusive.

Fibroma, Myxoma, Fibromyxoma and Other Tumors: These conditions are rare, slowly growing tumors as a rule, and biopsy must be resorted to for an accurate diagnosis.

Malignant Tumors.—The vast majority of malignant tumors of the antrum are squamous cell carcinomas. They grow fairly rapidly, and the patient usually consults the dentist first with a complaint of toothache. If there are any suggestive teeth on that side of the jaw, they are usually extracted, and in many cases an obviously noninfected tooth or teeth have been sacrificed at the insistence of the patient. There may be swelling of the soft tissues, but this does not usually occur unless the case has advanced without the confines of the antrum, and by that time metastases have appeared in the cervical chain. Sometimes

the soft tissues have become secondarily infected, and a fistula breaks through the gum or cheek. Biopsy is necessary for the diagnosis.

In all conditions in which the diagnosis is not apparent after careful clinical examination, a biopsy should be done and preparation made to execute radical surgical treatment immediately.

TREATMENT

The earliest form of treatment was simple aspiration or incision and drainage of the contents of the cyst. This had to be instituted quite frequently as the fluid in the cyst would reform and become infected, and a complete cure was not effected.

In 1868 Hulke [29] described accurately a dentigerous cyst of the maxilla, and said that he cut the outer wall of the cyst and laid a piece of lint in it to provoke suppuration, which occurred in three days. He irrigated the cavity for six months, at which time it had completely filled in.

In 1870 Thomas Bryant [3a] commented that:

> Our improved knowledge of the pathology of these cystic diseases of the upper and lower jaw (whether simple cystic or dentigerous) has taught us one practical lesson, that in every case in which the faintest suspicion exists of the cystic nature of the growth, operative interference should be confined to an exploratory operation before the grave one of extirpation of the growth is entertained.

He opened the cysts and packed them with lint, as did Hulke, and also removed teeth present in the cysts. The grave operation of extirpation in those days usually consisted of the removal of the entire maxilla on the side affected. The majority of surgeons did not recognize the benignity of the disease, and their attempts at surgical intervention in this fashion were attended with a high mortality, and the patients who did survive did not have a good cosmetic result.

Jay,[27] writing in 1895, said that his treatment of the cysts was:

> To open the cavity in the bone, remove the offending tooth or teeth, and pack it with gauze, thereby provoking healing by granulation tissue; or if desired to secure a rapid healing of definite nature to pack with Senn's decalcified bone chips; or by allowing it to fill in by Schede's blood clot method. The difficulty of preventing postoperative wound infection in the cavity of the mouth will make the packing of the cavity with gauze the only practical method to adopt.

Until the early part of the twentieth century, the custom generally was to make a wide opening in the canine fossa, pack with lint and irrigate, provoking suppuration and the formation of granulation tissue in an effort to obliterate the cavity. This treatment, although conserva-

29. Hulke: Cyst of Upper Jaw, Brit. M. J. **2**:613, 1868.

tive, did not give uniformly good results, recurrences and the formation of secondary occlusion abscesses being common.

In 1916 Guthrie [14] stated that:

> Until comparatively recent times the treatment of maxillary cysts of dental origin was far from satisfactory. It consisted generally of incision of the cyst through the expanded alveolar wall, followed by more or less incomplete removal of the lining by curetting. These attempts were not attended by success for the incision usually closed early or the antrum became infected and there remained a purulent draining fistula into the mouth.

The method of Partsch [7] was much used in the early nineteen hundreds. He advised against the removal of the lining membrane and the attempt to obtain healing by granulation and aimed at connecting the cavity with an epithelium-covered offset of the oral cavity. A flap of the alveolar mucous membrane where it covers the wall of the cyst was dissected up, and the underlying alveolar and part of the facial wall of the cyst was widely resected. A flap was then turned into the cavity, with the result that a permanent outlet was established and the lining membrane of the cyst soon became continuous with that of the mouth. After this condition had persisted for a long or short time, shrinkage usually took place and the cyst became eventually more or less obliterated. This sort of a procedure was necessarily a tremendous inconvenience and source of discomfort to the patient, and the end-result was not too gratifying.

Burger, Boenninghous and Hoffman advised a Caldwell-Luc operation early in 1900, as did Guthrie, and they were the first to advocate it.

The treatment of choice for a true dentigerous cyst of the antrum is now accepted as being a complete extirpation of the cyst and the bony shell wall through the usual vertical incision for the Caldwell-Luc operation in the canine fossa, at the point of greatest swelling. If the tumor has not assumed enormous proportions, this may be accomplished without any great displacement of the soft tissues. A large window in the antrum is made under the inferior meatus, and an opening in the middle meatus, where the ostium would naturally be, must be effected. The cyst has filled the antrum, and adhesions have probably formed over the opening. An effort should be made to maintain the patency of these openings permanently. The opening under the inferior turbinate should be maintained until the natural ostium has been covered with healthy mucous membrane and bids fair to maintain its patency. The incision is sutured, and beside irrigation of the antrum through the lower window once or twice, no further treatment should be necessary, unless secondary infection intervenes, to maintain the patency of the antronasal openings. The deformity will disappear quite rapidly if it is not exceedingly great.

SUMMARY

The word "dentigerous" means containing or bearing a tooth or teeth, and it seems to me to be a much better word to use in describing these cysts than "follicular" (used by some), which means developing from a follicle. It is possible and even probable that these cysts are formed at least in part from the follicle of a tooth, but that word itself does not distinguish it either pathologically or anatomically.

The characteristics of these cysts are: (1) a bony shell surrounding the entire tumor, easily separable from the wall of the antrum and from the soft tissue portions of the cyst, (2) a soft tissue layer composed of fibrous connective tissue, sometimes containing thin layers of cartilage or bony tissue with a lining of epithelium, usually stratified squamous epithelium, (3) a tooth, or teeth, completely or incompletely developed, contained in the cyst, the crown usually facing inward, and (4) a fluid contained in the cyst. When not infected, the wall of the cyst is comparatively thin, the subepithelial fibrous layer is quite dense, the epithelial layer is intact, and the fluid is thin and straw-colored and contains cholesterol crystals. When infected, the bony shell does not separate from the antral wall easily, the soft tissue layers are thick, vascular and infiltrated, and the epithelium is partially or completely destroyed. The fluid contents may be purulent, sanguinopurulent or of a thick caseous consistency.

The etiology is not exactly known, but it is probably a retention of fluid in the stellate reticulum of the follicle of the tooth that is situated between the cuticular dentin and the crown of the tooth, which distends the follicle into a cyst lined with epithelium. The theory held by many, that it develops from the so-called epithelial rests of Malassez, does not account for all the structures found.

The treatment consists in removing the entire cyst by careful dissection through as small an opening in the canine fossa as possible, closing that entrance, and providing for subsequent drainage by the making of a good sized naso-antral window under the inferior turbinate. This should be done entirely transantrally so as not to traumatize the intranasal structures.

When the entire cyst has been removed, the prognosis in these cases is excellent. The cysts do not metastasize, and malignant degeneration has not been reported. The deformity caused by the tumor recedes rapidly after removal, except in cases in which it has attained great size. Secondary infection of the antrum can be controlled or prevented from assuming serious proportions by maintaining the patency of the naso-antral window and instituting antral lavage until any infection has disappeared.

CONTACT ALLERGIC CORYZA

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Every one who has attempted to establish the atopic character of cases of vasomotor rhinitis has encountered instances in which this was impossible. These cases present a family and personal history that is entirely free from asthma, hay fever, hives and other typical manifestations of atopy. Complete tests of the skin for protein sensitization with extracts of the inhalants, contactants, all of the foods that are taken by the patient and all the ordinary bacteria fail to give a single positive reaction. Yet these patients give a description of their trouble which forces the physician to believe that they suffer from an allergic coryza. Examination of smears from the blood and nasal secretion shows an increase in the eosinophils. Examination of the nasal mucosa reveals the typical pale membrane of an allergic person. Such cases present a real problem both as to diagnosis and as to treatment. It is the purpose of this article to call attention to what I believe is a solution of the problem.

To this group I have given the rather unsatisfactory but suggestive name of "contact allergic coryza" because the condition more closely resembles contact dermatitis than any of the other recognized forms of allergy.

In the study of all forms of coryza, I have found the accompanying outline helpful. The vast majority of cases of allergic coryza will turn out to be atopic, and occasionally the atopen will be found to be a bacterium. When that is the case the intracutaneous injection of the offending bacterium will give an immediate reaction, and the specific antibodies (reagins) can be demonstrated by passive transfer. Some cases which are not atopic can be proved to be instances of bacterial allergy. These cases will give delayed reactions to skin tests much like those seen with tuberculin. Rarely is a vasomotor rhinitis the result of physical allergy.

When, by the processes of elimination suggested in the outline, the opinion is arrived at that the case is one of local contact allergic coryza the history of the case becomes of prime importance. The method of investigation is the slow and tedious one of spraying properly diluted solutions of the suspected materials into the nose. Only one substance can be tested at a sitting. Consequently much time can be saved by a careful review of the history of the case. Frequently the patient him-

self is suspicious of a certain agent which proves to be the real offending substance. Again in many instances the occupation of the patient will suggest the offending substance just as it does in contact dermatitis.

Contact allergic coryza is not a recently recognized syndrome. Throughout the ages it has been recognized that the smell of certain volatile oils or perfumes always produces in some persons an acute coryza which clears up as soon as the offending substance is removed. I have seen three cases in which the volatile oils in perfumes were the specific cause of vasomotor rhinitis. This is well recognized and has already been taken into account by at least two of the leading manufactures of "nonallergic" cosmetics.

Although I have never had the opportunity to study such a case, I am familiar with the history of several chemists or their helpers in industry in whom a chronic vasomotor rhinitis developed which was believed to be due to a specific hypersensitization toward an inorganic chemical released in the laboratory regularly in the day's work.

REPORT OF CASES

Two of the cases occurred in men past middle life who for years had been steady drinkers of whisky. In both the appearance of the nasal mucosa was typical of an allergic coryza and had been so recognized by the rhinologist who sent the patients to me. The family histories were negative for all forms of atopy. The coryza was the only allergic manifestation that either patient had exhibited. Complete tests of the skin with inhalants, contactants, foods and bacteria gave negative results. There was an eosinophilia in the nasal secretions. It was clear, then, that I was dealing with an allergy which was not atopic or bacterial. The patients themselves suspected ethyl alcohol. The holding of a glass of 10 per cent ethyl alcohol in front of the nose promptly induced a severe attack of sneezing. The exhibition of a glass of wine and later of a rather strong home brew had the same effect. Avoidance of these substances brought relief. Repeated tests indicated conclusively that ethyl alcohol was the offender in both cases.

Another case was that of a pathologist who was seized with coryza whenever the air contained the faintest trace of formaldehyde. He, too, presented an eosinophilia in the nasal secretions during an attack. There was no history of atopy in his family, and these attacks were the only allergic manifestation that he himself had ever exhibited. He showed negative reactions to complete tests of the skin, and avoidance of formaldehyde gave complete relief. It was only when he encountered formaldehyde that the coryza developed.

SUMMARY

Vasomotor rhinitis is usually due to allergy. Allergic coryza is, as a rule, atopic. Sometimes it is due to bacterial allergy. At times it represents a local contact sensitization.

A diagnostic outline is presented which should prove helpful in the differentiation of the various kinds of coryza.

Differentiation of Various Types of Coryza (Acute or Chronic)

I. Allergic coryza characterized by itching, paroxysmal sneezing, profuse nasal discharge uniform swelling of turbinates, grayish-white mucosa, and eosinophilia

1. Atopic coryza

Peculiar to only a small percentage of mankind in whom the capacity to become specifically hypersensitive to substances, usually protein, is inherited as a dominant mendelian character; this specific sensitization may occur at any time in life, even in utero; specific antibodies which are peculiar to the patients themselves may be demonstrated by passive transfer

The recognition of such a state in a given case of coryza rests on four essential criteria, viz.:

(a) A family history of asthma, hay fever and other atopic manifestations

(b) A personal history of one or more atopic manifestations as stated

(c) An eosinophilia in the blood and nasal secretions during the attack

(d) Some positive reaction to cutaneous tests for protein sensitization

When a person with an atopic constitution and an inherited tendency to develop the potential hypersensitivity in the nasal mucosa meets

A specific sensitizing substance (called atopen) which may reach the potentially hypersensitive cells of the lining of the nose by absorption through the blood and lymph; this may be

1. All types of atopens, such as
   - Pollens
   - Spores of fungi
   - Emanations from animals or fowl
   - Powdered proteins:
     - Orris root and rice powder in cosmetics
     - Others encountered in the day's work, wheat flour in baking; carotid, ipecac, and lycopodium in handling of drugs, etc.
2. Foods by ingestion
3. Protein extracts by injection

With or without the added influence of

A nonspecific aggravating or secondary factor, such as

(1) Barometric changes
(2) Heat or cold
(3) Light
(4) Emotional upsets and worry
(5) Fatigue
(6) Focal infections
(7) Acute and chronic infections
(8) Constipation
(9) Bodily deficiencies:
- Malnutrition
- Calcium deficiency
- Hypochlorhydria or achlorhydria
- Deficiencies of ductless gland, thyroid, etc.

The result is

Allergic
Ther
rathe

An allergic reaction

2. Bacterial allergy

Brought about by a previous infection and kept up by absorption from a focus of infection

The recognition of this state rests on:

(a) The elimination of atopy by a study of the case

(b) The history of infection and the demonstration of a focus

(c) Delayed cutaneous reactions to intracutaneous injections of the offending bacteria

3. Contact allergic coryza

Like contact dermatitis, this form of allergic coryza can occur in almost any person at any time in life on adequate exposure; it is not controlled by inheritance and there are no antibodies similar to those found in atopy

The recognition of this state in an allergic coryza rests on:

(a) The elimination of atopy and bacterial allergy by proper study of the case

(b) The history of proper exposure

(c) The identification of the offending substance by test application to the nasal mucosa of the suspected substances

(d) Relief on avoidance of the offending substances

4. Physical allergic coryza, specific sensitization

5. Physical allergic coryza
Specific sensitization to the effects of heat, cold, light and other physical agents

The recognition of this state rests on:

(a) The elimination by careful study of all other forms of allergic coryza

(b) The history of the case

(c) The production of the coryza by the exhibition of the offending agent

(d) The relief on avoidance

II. Nonallergic coryza

1. Infections, common colds, etc.

2. Nonspecific vasomotor rhinitis
The diagnosis rests on the elimination of all of the enumerated possibilities and the finding of the reflex cause

oryza (Acute or Chronic)

- cific sensitizing substance (called
-) which may reach the potentially
- ensitive cells of the lining of the
- y absorption through the blood
- mph; this may be
  - All types of atopens, such as
    - Pollens
    - Spores of fungi
    - Emanations from animals or fowl
    - Powdered proteins:
      - Orris root and rice powder in cosmetics
      - Others encountered in the day's work, wheat flour in baking; carotid, ipecac, and lycopodium in handling of drugs, etc.
  - Foods by ingestion
  - Protein extracts by injection
  - With or without the added influence of
    - specific aggravating or secondary factor, such as
      -) Barometric changes
      -) Heat or cold
      -) Light
      -) Emotional upsets and worry
      -) Fatigue
      -) Focal infections
      -) Acute and chronic infections
      -) Constipation
      -) Bodily deficiencies:
        - Malnutrition
        - Calcium deficiency
        - Hypochlorhydria or achlorhydria
        - Deficiencies of ductless gland, thyroid, etc.

The result is

- Allergic equilibrium (Vaughan)
  - There are no clinical manifestations but rather a state of tolerance
- An allergic reaction
  - Local reaction in the nose and its accessory sinuses
    - Allergic coryza
      - Seasonal
        - Spring colds (trees)
        - Summer or rose colds (grasses)
        - Fall hay fever (weeds)
      - Nonseasonal
  - General reaction (allergic shock)
    - (1) Collapse
    - (2) Subnormal temperature
    - (3) Slow pulse
    - (4) Lowered blood pressure
    - (5) Prolonged blood coagulation
    - (6) Increased blood nonprotein nitrogen
    - (7) Decreased blood calcium, phosphorus and chlorides
    - (8) Lowered blood sugar
    - (9) Leukopenia

UNIV. OF MICH.

This article is written as a solution to the problem of what to do for the "nonreactor" with a coryza which resembles in all other details the allergic forms.

At the present time the treatment of this type of coryza consists in strict avoidance of the offending substance once it has been identified with certainty.

A NEW TECHNIC IN THE SURGICAL TREATMENT OF OZENA

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Surgical measures are not as frequently employed for the treatment of ozena as for other nasal conditions. Such treatment is more popular in Europe than in this country. There may be several reasons for the unpopularity of its employment in ozena: (1) prejudice against the use of any procedure for a disease with an unknown etiology; (2) failure to understand how a surgical procedure, which brings about a physical change in the nose, can help a condition with such an extensive and destructive pathologic process as ozena presents; (3) the resistance of the process to all palliative measures, and (4) a prevailing unfamiliarity with the surgical technic.

Ozena is to the rhinologist what otosclerosis is to the otologist. Both conditions are chronic, have a tendency to progress and show peculiar pathologic changes which are circumscribed and have few known systemic consequences. Both are of far-reaching social and economic importance.

As for ozena, Lautenschläger [1] expressed the belief that those suffering from it never reach old age, frequently succumbing to systemic disorders, which may have a relationship to the failure of the nose to perform its physiologic function of warming, moistening and filtering the inhaled air before it enters the lungs.

Having paid special attention to the problem of ozena for the past nine years.[1a] I have found surgical intervention the best and most lasting therapeutic means among the numerous approaches recommended to combat the formation of crusts and the fetor. Operation is advocated

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1. Lautenschläger, A.: Die Rhinitis atrophicans, in Denker, A., and Kahler, O., Handbuch der Hals-, Nasen- u. Ohrenheilkunde, Berlin, Julius Springer, 1926, vol. 2, p. 604.

1a. Wachsberger, Alfred: The Surgical Aspect of Ozena, M. J. & Rec. **135**: 128 (Feb. 3) 1932; Rôle of the Sympathicus and Parasympathicus in the Etiology of Atrophc Rhinitis, Arch. Otolaryng. **13**:265 (Feb.) 1931; Modification of the Lautenschlaeger Operation for the Surgical Treatment of Ozena, Laryngoscope **42**:870 (Nov.) 1932; The Significance of Blood Cholesterol in Atrophic Rhinitis, ibid. **42**:749 (Oct.) 1932.

for genuine ozena only, and not for cases of simple atrophic rhinitis, the symptoms of which are not severe enough to warrant surgical intervention.

HISTORY OF SURGICAL TREATMENT OF OZENA

Surgical methods have changed with the variations in the conception of the etiology of ozena. When Grünwald [2] held that the pathologic secretion, which dries to form crusts, originates from infections of the paranasal sinuses, a radical surgical procedure on the sinuses was advocated, and this is still the practice of some rhinologists. Lautenschläger was the first to prove that the pathologic secretion in ozena is produced by the mucosa of the nasal chamber itself; while the paranasal sinuses, and especially the antrums, are usually found to be empty when they are opened. This, at least, is the rule. Exceptionally, a transudate or an exudate may be present within the antrum, but this is explained as a coincidental happening, and not as characteristic of ozena. On the other hand, there are cases of chronic empyema of the antrums of extremely long standing which produce a secondary atrophy of the nasal mucosa. These are too often classed as cases of ozena because there is an occasional development of crusts and fetor, which, however, to an experienced observer differ from the crusts and fetor in genuine ozena. Radical eradication of the secreting sinus membrane in such cases will result not only in a disappearance of the objective symptoms but often in an improvement of the atrophic condition as well.

This, however, does not hold true in genuine ozena. Here a radical surgical procedure on the sinus is followed by a brief period of improvement which, in my opinion, is due to the traumatic reaction from the surgical procedure and the resultant stimulation caused by the reabsorption of the extravasated blood, which has the same effect as an injection of a foreign protein. The same short-lived improvement can be achieved by injecting the patient's blood, previously drawn from the cubital vein, into the turbinates. When this reaction subsides, which happens between four and six weeks after the operation, the condition either returns to the same state as before or it becomes even worse, particularly when the turbinates or the naso-antral wall was removed in the procedure.

The history of the given case, careful and repeated inspections, probatory irrigation of the suspected sinus cavities and a roentgenogram will help one to make a differential diagnosis between genuine rhinitis atrophicans foetida et crustosa and conditions which resemble it clinically, and will prevent the performance of unnecessary and harmful surgical procedures. The operations for genuine ozena, which are described

2. Grünwald, L.: Der heutige Stand der Ozaenafrage, Arch. f. Laryng. u. Rhin. **13**:250, 1902.

later, are less effective and sometimes impossible to perform when needed parts have previously been removed from the nose during the surgical attack on the sinuses.

Believing that the removal of the atrophic membrane of the nose may result in the regeneration of a healthy mucosa with normal secretion, Rouge [3] recommended curettement of the entire nasal chamber. The results were disappointing, and this procedure is generally discarded.

Extensive operations have been undertaken because of the belief that the autonomic nervous system plays an important rôle in the etiology of ozena. This theory assumed that a spasm of the vasoconstrictor nerves of the nose caused the atrophy and the other symptoms. Blockage or extirpation of the sphenopalatine ganglion and also periarterial sympathectomy on the large vessels of the neck have been followed by short periods of improvement. Blockage and extirpation of the sphenopalatine ganglion, however, destroys the sensory fibers of the nasal mucosa along with the vasomotors and interrupts the reflex production of mucus; this still further adds to the dryness of the membranes. Vogel's [4] work has proved that the fibrotic degeneration of the sphenopalatine ganglion in ozena is secondary to the nasal pathologic process and does not precede it. Therefore, surgical procedures based on this theory are unfounded.

Removal of the turbinates, as originally recommended by Volkmann,[5] is not practiced today because it definitely results in an aggravation of the condition.

Lautenschläger,[6] in 1916, was the first to call attention to the beneficial effects of narrowing the lumen of the nasal cavity in cases of genuine ozena and to warn against the removal of intranasal structures, which would result in a widening of the nasal cavity and in an aggravation of the symptoms.

Before entering into the description of those surgical methods which narrow the nasal cavity, I wish to deal with the principles that underlie these procedures. Regardless of whether it is the cause or the effect, the fact remains that unusually wide nasal cavities are usually seen in all cases of ozena. This abnormal width is brought about by the atrophy of the turbinates, and by a disproportion between the length, width and

3. Rouge: Nouvelle méthode pour le traitement chirurgical de l'ozéne, Lausanne, Rouge & Dubois, 1873.

4. Vogel, Klaus: Histopathologische Befunde des Ganglion sphenopalatinum mit besonderer Berücksichtigung der atrophischen Rhinitiden, Ztschr. f. Hals-, Nasen- u. Ohrenh. **21**:507 (Feb. 16) 1929.

5. Volkmann: Versuch einer operativen Behandlung der Ozaena simplex, Zentralbl. f. Chir. **9**:65, 1882.

6. Lautenschläger, A.: Operative Behandlung atrophischer Zustände des Naseninneren, Berl. klin. Wchnschr. **54**:445, 1916.

height of that part of the facial skeleton which forms the bony framework of the nose. Steiner [7] showed that the length of the nose, when measured between the anterior and posterior nasal spine, is shorter in people suffering from genuine ozena than in normal persons. This is the result of a standstill in the development of the facial skeleton which also manifests itself in the underdevelopment of the sinuses, the disproportion between the cranial and the facial parts of the skull and the preservation of the proportions of the child's nose, which normally develops in height and length more than in width. Genuine ozena has not been observed in a really narrow nose.

From cases of unilateral ozena and a marked septal deviation toward the side in which no crusts are present, it is permissible to conclude that the narrowness of that side is responsible for the fact that ozena does not develop. This assumption finds support in my observation of several patients on whom a submucous resection had previously been performed and who stated that the formation of crust had increased on the formerly obstructed side after the submucous operation. Genuine ozena is always bilateral in equally wide nasal fossae; and the wider the nose, the more severe are the symptoms.

Having established the fact that the nasal cavity is disproportionately wide in ozena, the question arises, what is the effect of the abnormal width on the mucous membrane? A greater quantity of air passes through the nose during respiration and increases the evaporation of the secretion which normally coats the surface of the mucosa. Since the freshly produced secretion in ozena already has a high viscosity, the drying effect of the increased amount of air passing by will promote the formation of crusts. These crusts injure the sensitive ciliary apparatus which, in turn, causes the stagnation of the secretion, leading to additional formation of crusts. When these crusts are forcibly removed, the columnar epithelium is destroyed. Such an epithelial defect is not replaced by ciliated columnar cells but by stratified squamous cells because of the altered conditions in the nose. The impact of the increased amount of air and the pressure from the dried secretion favor the formation of the less vulnerable squamous cells. This explanation for the occurrence of the islands of stratified squamous epithelium in ozena is much more logical than the assumption of a direct metaplasia from the one cell form into the other, as was believed by Schuchardt.[8] The point to be stressed here is that the unusual width

7. Steiner, M.: Zur Weiterentwicklung der Lehre von der Ozaena, Arch. f. Laryng. u. Rhin. **21**:282, 1908.

8. Schuchardt: Ueber das Wesen der Ozaena, Arch. f. klin. Chir. **39**:211, 1889.

of the nose is indirectly responsible for the change in the epithelium and for the formation of crusts.

This assumption is further substantiated by the fact that in ozena crusts and squamous epithelium have never been observed in the paranasal sinuses, in which the circulation of air is by far less rapid than in the nose itself. When, on the other hand, a wide communication is made between the main nasal cavity and the sinuses, crusts will soon develop in the sinuses. This is another reason why radical operations on the sinuses are contraindicated for the cure of genuine ozena.

The following simple experiment readily illustrates the relationship between the abnormal width of the nasal chamber and the objective pathologic process. If a patient having ozena inserts a simple cotton plug into each nostril so as to eliminate nasal respiration for twenty-four hours, the nasal mucosa will present an entirely different picture on removal of these plugs. It is moist and less pale, and if crusts were present before, these will be found to be soft and often lying as detached masses on the floor of the nose. Saenger and Sondermann [9] made use of this therapeutically, and prescribe special obturators to be worn by the patient at night.

The detrimental effect of the unusual breadth of the nasal chamber on the circulation of the blood can also be demonstrated. In a normally wide nose there occurs a change from negative to positive air pressure with inspiration and expiration, as has been shown by Neumann,[10] and lately by Proetz.[11] If the nasal passages are narrow, owing to an obstruction, and if nasal respiration is maintained, there will result an increase in the pressure during expiration and a decrease during inspiration. If, on the other hand, the nasal passages are unusually wide, the opposite will take place. While the resistance to the respiratory air pressure in a normal person is found to be much greater in the nose than in the mouth, this difference is equalized in patients with ozena. The significance of this change in respiratory pressure, while adequately appreciated in regard to its effect on ventilation and drainage of the sinuses, is underestimated in regard to the effect it has on the circulation of blood in the nasal mucosa. Although the dependency of the circulation on the changes in respiratory pressure in the nose has never been recorded, because of inherent technical difficulties, it can safely be assumed that such a relationship does exist,

9. Saenger, M., and Sondermann: Ozaenatherapie; Nasenobturator, Therap. Monatsh. **8**:502, 1894.

10. Neumann, H.: Atmung bei atrophischen Nasen, Beitr. z. Anat., Physiol. u. Path. d. Ohres **20**:289, 1924.

11. Proetz, A. W.: Displacement Method of Sinus Diagnosis and Treatment, St. Louis, Annals Publishing Co., 1931; Five Preliminary Notes on Nasal Function, Ann. Otol., Rhin. & Laryng. **41**:1117, 1932.

from comparison with conditions in the chest and from the hyperemia encountered in the nasal mucosa after the application of mass suction.

A sluggish circulation of the blood could easily be the cause of the diminished secretory activity of the nasal glands and the decrease of the water content of the secretion. It may also accelerate the progress of the atrophy.

The aforementioned physical considerations, as presented by the problem of ozena, have been dealt with in detail because they form the rational basis for the nasal narrowing operations, and they explain the results obtained from these procedures. To hold the physical factors solely responsible for the production of ozena is not attempted or deemed possible in my opinion.

Numerous methods have been recommended for narrowing the nasal cavity by the implantation of autoplastic or heteroplastic material. This is deposited in a pocket formed by an incision in the mucosa. The septum or the inferior meatus is usually chosen for this procedure because the mucosa there is more apt to be in good condition, since it is kept moist by the tears emptied through the lacrimal duct. The disadvantage of this is that fistulas frequently form at the site of the incision, and the implanted material is finally discharged through them. To avoid this, it has been recommended that one deposit the material through an incision in the upper vestibule of the mouth and so avoid incision of the nasal mucous membrane. Several kinds of material have been used for this: paraffin, celluloid, gutta-percha, fat, rib, cartilage and fascia. Bone from the tibia and ivory, as implanted by Pollock,[12] did not prove as efficient as spongy beef-bone in the experiments of Eckert-Möbius.[13]

This operation has the advantage of being very simple. Its disadvantages are that fistulas may form, through which the implanted material, acting like a foreign body, will be discharged, or that, if fat is used, it will be resorbed in a comparatively short time. In either case, the operation must be repeated a number of times to give the patient permanent relief.

In 1916, Lautenschläger [6] published his method, which he evolved in the course of a radical operation on the antrum, and which is the basis of the method most frequently used today. Its principle is to narrow the nasal cavity, not by implanting foreign materials in it, but by transposing the lateral nasal wall on both sides toward the septum.

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12. Pollock, H. L.: Treatment of Atrophic Rhinitis by Ivory Implants, Ann. Otol., Rhin. & Laryng. **36**:241, 1927.

13. Eckert-Möbius, A.: Implantation von maceriertem spongiösem Rinderknochen zur Behandlung der Rhinitis atrophicans simplex et foetida, Ztschr. f. Hals-, Nasen- u. Ohrenh. **7**:108, 1923.

A brief description of Lautenschläger's method follows: The incision is the same as for the Caldwell-Luc operation. A large window is resected from the facial wall of the antrum. The removed bone is kept in warm saline solution for later reintroduction. The antral mucosa is completely removed, even when macroscopically of normal appearance, because of possible postoperative infection. The naso-antral wall is then cut along the floor, infracted in several places and pushed toward the septum. The ethmoid is opened through the antrum and curetted, if necessary, and the middle turbinate is pushed medially. All this is done with care so as not to injure the mucosa of the nasal chamber proper. In severe cases Lautenschläger exposes the pyriform crest, removes part of it and places it along with the fragments which he secured from the facial wall in a tunnel in the nasal side of the naso-antral wall, after elevation of the mucoperiosteum. Adhesions between the turbinates and the septum may or may not be produced by previous scarification of the parts approximated. Firm packing in the antrums holds the lateral wall in its new position.

Wittmaack,[14] to improve further on Lautenschläger's operation by keeping the nasal mucosa moist, transplanted the orifice of the parotid duct into the antrum. A mucous membrane flap containing the orifice is cut and swung into the wound in the buccal fold, which is then sewn together. A disadvantage is that saliva drips from the nose during mastication, and for that reason the method has become unpopular.

Hinsberg,[15] in his modification of the Lautenschläger operation, uses a bronze wire with a magnesium plate at each end to hold the lateral wall in place instead of the packing. The wire is introduced by means of a slightly curved needle, which is carried through the naso-antral wall on one side, then through the septum and finally through the naso-antral wall on the other side.

Halle's [16] modification eliminates the incision in the alveololabial fold and transposes the lateral wall through an entirely endonasal operation. His technic is briefly as follows: An incision is made in the lateral nasal wall through the mucoperiosteum from a point anterior to the head of the middle turbinate downward to the nasal floor, passing in front of the head of the inferior turbinate. Through this incision elevation of the mucoperiosteum, below the insertion of the inferior turbinate and of the nasal floor, is accomplished. The bony lateral

14. Wittmaack, K.: Ueber eine neue biologische Behandlungsmethode der Ozäna, Deutsche med. Wchnschr. **14**:70, 1919.

15. Hinsberg, V.: Zur operativen Behandlung der Ozaena, Monatschr. f. Ohrenh. **21**:1269, 1921.

16. Halle, M.: Die operative Therapie der Ozaena, Arch. f. Laryng. u. Rhin. **33**:751, 1920.

wall is then cut with a chisel, starting midway between the anterior tip of the middle and inferior turbinate and continuing down along the line of the previous incision in the mucosa to the floor, then along the floor backward as far as the posterior tip of the inferior turbinate and from there upward in a right-angle as far as the bony wall has been exposed. The bone of the lateral wall which is exposed by the upper portion of the anterior incision in the mucosa is indented with the chisel but not completely cut through. Underneath this indented line lies the nasolacrimal duct which may be injured if the bone is cut through its thickness. A strong elevator is then introduced into the antrum through the anterior part of the incision, and the lateral wall is pushed toward the septum and held in place by packing the antrum with iodoform gauze. Previous scarification of the turbinates and the septum will lead to adhesions which hold the lateral wall in the approximated position.

A method which has been described by Borries [17] in a Danish publication in 1926 has come to my attention only recently. Borries approaches the antrum from an incision in the sulcus alveololabialis and chisels a window into the facial wall of the antrum. In the next step he mobilizes the pyriform crest together with the naso-antral wall and transposes both medially toward the septum. The bone fragment, which he removes from the facial wall, is now wedged in between the crista pyriformis and the frontal process of the upper maxilla, thus holding the transposed lateral wall in its new position without adhesions or packing of the antrum.

Borries' method is very similar to my modification which I developed in 1927 without knowledge of Borries' publication. It differs, however, in the approach in that my operation is performed entirely through the nose while Borries uses the oral route.

The foregoing description of the different methods will help one to understand my modification, the reason for which is to simplify the operation for the patient as well as for the surgeon and, at the same time, to make it more effective.

TECHNIC

Anesthesia.—Scopolamine hydrobromide (from 1/200 to 1/100 grain [0.0003 to 0.0006 Gm.]) combined with morphine (from ⅛ to ¼ grain [0.0081 to 0.0162 Gm.]) is injected subcutaneously one hour before operation. Until that time the patient is kept in a prone position in a darkened room. Cotton pledgets soaked in equal amounts of alypin (from 10 to 30 per cent) and epinephrine (1:1,000) and carefully squeezed to remove the excess fluid are inserted on either side into

17. Borries, G. V. T.: Bidrag til ozaenaens operative behandling, Hospitalstid. **69**:184, 1926.

the inferior and the middle meatus. Procaine hydrochloride (0.5 per cent solution) is then injected into the sphenopalatine ganglion by the external buccal and infrazygomatic route. On withdrawing the cannula, a small amount of procaine hydrochloride is deposited at the tuber maxillare for anesthesia of the posterosuperior dental nerves, thus eliminating the anesthetization of the mucosa which lines the interior of the antrum after the antrum is opened. After the removal of the cotton pledgets from the nose, procaine hydrochloride is injected into the septum and the entire lateral nasal wall. An injection is made into the alae nasi, and from there the needle is pushed toward the infra-orbital foramen, as close to the bony facial wall as possible, depositing procaine hydrochloride as it is advanced. Injection into the columella will help to ease the pain when the nostril is stretched. General anesthesia, preferably by the endotracheal method, may be employed in young adults.

Operation.—The medial side of both turbinates and the parts of the septum opposite are scarified with a knife. An incision along and on the facial side of

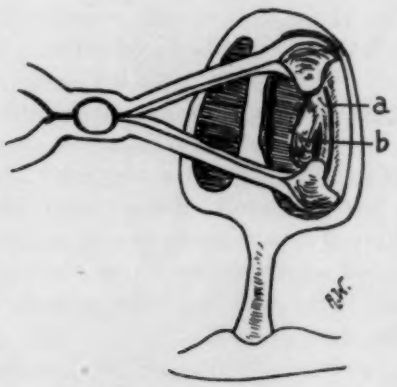

Fig. 1.—First step in the operation: *a* shows the skin incision; *b* the inferior turbinate.

the pyriform crest, extending from the insertion of the inferior turbinate down to the nasal floor, is made and carried through the skin and periosteum (the same as in the Canfield-Sturman method for the radical operation on the antrum). This is followed by elevation of the periosteum over the facial wall for about one-half inch, and then by loosening of the periosteum at the height of the pyriform crest by scraping it with the edge of a chisel. This facilitates the undermining of the mucoperiosteum along the naso-antral wall below the inferior turbinate and the floor of the nose. A medium-sized Killian speculum is then inserted into the wound, its branches protecting the soft parts of the cheek on one side and the mucoperiosteum on the nasal side, thus exposing the anterior and medial bony wall of the antrum. Where the facial wall turns from the sagittal to the frontal plane (the distance from the pyriform crest depends on the extent of pneumatization of the upper part of the maxilla), an incision parallel to the pyriform crest is made into the facial wall with a chisel, from the level of the insertion of the inferior turbinate down almost to the level of the nasal floor. The upper end of this incision is extended upward and medially until it severs the continuity of

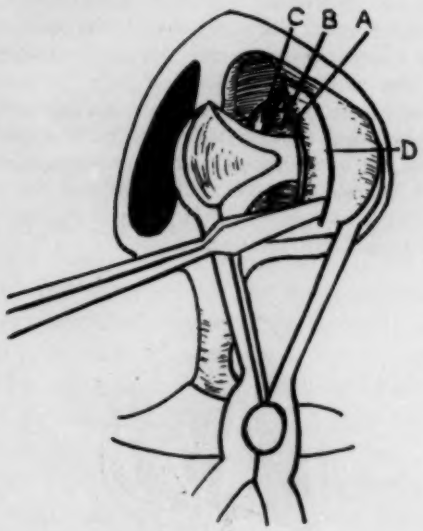

Fig. 2.—Second step in the operation: *A* indicates the crista pyriformis; *B*, the mucoperiosteum, naso-antral wall; *C*, the inferior turbinate, and *D*, the incision in the bony facial wall of the antrum.

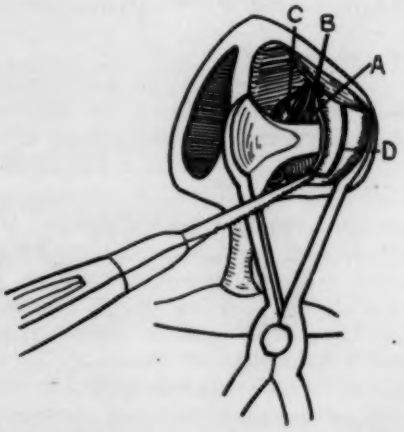

Fig. 3.—Third step in the operation, showing the use of Halle's saw for completion of the incision. The letters designate the same areas as in figure 2.

the pyriform crest. The lower end of this incision is extended medially at a right-angle and severs the pyriform crest as near to the nasal floor as possible.

Difficulty may be encountered here because of the great thickness and density of the bone, as is often found in ozena. I have found Halle's saw, which is ordinarily used in plastic operations on the nose, the most suitable instrument for this. The bone is sawed from within outward.

The cutting of the naso-antral wall backward and along the nasal floor is the next step and is accomplished with my bone scissors, as described elsewhere. If a chisel is used instead, the outer branch of the speculum, which had been used to retract the cheek, is inserted into the antrum through the incision in the facial wall, and the naso-antral wall is then held between the speculum, not unlike the septal cartilage in a submucous resection.

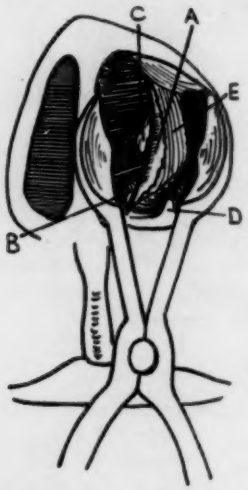

Fig. 4.—Last step in the operation: *A1*, crista pyriformis and part of the bony facial wall of the antrum; *B*, mucoperiosteum of the nasal floor, folded; *C*, inferior turbinate; *D*, ridge between the nasal and antral floor; *E*, naso-antral wall, antral aspect.

The next step is the transposition of the lateral wall. A thin but rigid elevator is introduced into the antrum through the incision into the facial wall. With this, firm pressure is exerted against the naso-antral wall at all parts which can be reached posteriorly and superiorly, forcing this wall medially toward the septum until the turbinates are in apposition with the septum. It is advisable to approximate the lateral nasal wall as close as possible to the septum because of the postoperative retraction which invariably takes place. Firm packing of the antrums with gauze treated with iodoform and petrolatum concludes the operation.

After-Care.—The packing is removed after five days, at which time adhesions are expected to have developed between the septum and the turbinates. The antrums may have to be repacked for another period of five days if the adhesions do not appear firm enough. They must extend backward along the entire length of the turbinates. The antrums are irrigated through the wound in the nasal vestibule with a straight dull cannula each time the packing is changed and after

it has finally been removed. The wound is allowed to close when the return fluid appears clear.

Some swelling about the cheek and the lower eyelid occurs on the second and third day after operation, but yields easily to cold compresses. A slight swelling in the nasolabial fold, which remains as long as the antrums are packed, disappears quickly after the removal of the packing. Tearing of the eyes, due to pressure of the packing on the nasolacrimal duct, is observed in some cases. This, however, ceases when the packing is removed. Until that time an eye wash of boric acid may be advantageously used several times daily.

The advantages of this method, when compared with the others mentioned, are as follows: The operation is done through the nose. It is done without any incision into the nasal mucosa, thus preventing permanent openings into the antrum as occasionally occur when Halle's method is used. The antrum may then develop crusts through the added width and because of the free circulation of air in it. My method is applicable and as successful in persons with small antral cavities as it is in persons with antrums of normal size. Mobilization and transposition of the most anterior part of the lateral nasal wall result in narrowing of the nasal cavity to a greater degree and make this method suitable for advanced cases. It is easier to perform technically, and the after-treatment is simpler.

As for postoperative complications, I have observed one patient in whom a chronic dacryocystitis developed. Resection of the tear sac cured the condition. Empyema of the antrum developed in another patient, and irrigation and drainage were obtained through the operative wound, which was kept open for that purpose until the pathologic exudate disappeared.

The results obtained with this operation may be explained in the following way: By actually reducing the volume of the nasal cavity and relatively enlarging its surface, a smaller quantity of air passes over a larger surface. As a result, oxidation and evaporation of the mucous membrane and the mucus it produces are lessened, and the mucosa stays moist. The normal change from positive to negative pressure with exhalation and inhalation, which is absent from the nose in ozena, is restored and improves the circulation of the blood. This, in turn, has a stimulating effect on the nasal glands and a favorable influence on the atrophy in general. The establishment of adhesions between the septum and the turbinates creates new anastomoses in the circulation of the blood. Another important result is that the patient can again clean his nose himself by blowing.

Disregarding the transient traumatic reactions following the operation, the objective resulting changes in the nose are: disappearance of the pallor and dryness of the mucosa and disappearance of the crusts except for occasional soft scabs in the nasopharynx in a few less success-

ful cases. The occurrence of polyps in three cases after operation is an interesting observation because it demonstrates how an extreme atrophy was converted into a hypertrophic condition. The first operation, with this modification, was performed in 1928. The patient was seen recently, and his condition was as good after five years as it was on discharge.

While statistics on the results of the different nasal narrowing operations show cures in from 75 to 100 per cent of cases, all writers on the subject agree that the fetor disappears in all instances. Since fetor is the most annoying symptom to the patient, this fact alone makes the operation worth while.

51 West Seventy-Third Street.

TREATMENT OF ANGINA PECTORIS AND CONGESTIVE HEART FAILURE BY TOTAL ABLATION OF THE THYROID

V. IMPORTANCE OF LARYNGOSCOPIC EXAMINATION AS A MEANS OF PREVENTING BILATERAL PARALYSIS OF THE VOCAL CORDS

LOUIS M. FREEDMAN, M.D.
BOSTON

Blumgart and his co-workers,[1] at the Beth Israel Hospital in Boston, recently reported the therapeutic results of total ablation of the thyroid gland in patients with angina pectoris or congestive heart failure. Berlin,[2] who developed and first described the operation, realized at the outset the danger of injury to the recurrent laryngeal nerves because of the intimate anatomic relation between the thyroid and these nerves. This relationship is particularly close just below the arch of the cricoid in the area of fixation of the thyroid to the trachea, which Berlin described as the "adherent zone." In this area the nerve often traverses strands of fascial tissues connecting the thyroid to the trachea and has a varying relationship to the inferior thyroid artery. Berlin and Lahey [3] showed that the recurrent laryngeal nerve is more often anterior to the inferior thyroid artery on the right than on the left side of the neck.

To gain information regarding the laryngeal complications of the operation and to obviate the disastrous possibility of bilateral paralysis of the vocal cords, the following program was carried out. In each

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From the Department of Otolaryngology of the Beth Israel Hospital.

1. Blumgart, H. L.; Levine, S. A., and Berlin, D. D.: Congestive Heart Failure and Angina Pectoris: The Therapeutic Effect of Thyroidectomy on Patients Without Clinical or Pathologic Evidence of Thyroid Toxicity, Arch. Int. Med. **51**:866 (June) 1933. Blumgart, H. L.; Riseman, J. E. F.; Davis, D., and Berlin, D. D.: Therapeutic Effect of Total Ablation of Normal Thyroid on Congestive Heart Failure and Angina Pectoris: III. Early Results in Various Types of Cardiovascular Disease and Coincident Pathologic States Without Clinical or Pathologic Evidence of Thyroid Toxicity, ibid. **52**:165 (Aug.) 1933.

2. Berlin, D. D.: Therapeutic Effect of Complete Thyroidectomy on Congestive Heart Failure and Angina Pectoris: II. Operative Technique, Am. J. Surg. **21**:173, 1933.

3. Berlin, D. D., and Lahey, F. H.: Dissections of the Recurrent and Superior Laryngeal Nerves; the Relation of the Recurrent to the Inferior Thyroid Artery and the Relation of the Superior to Abductor Paralysis, Surg., Gynec. & Obst. **49**: 102 (July) 1929.

case the larynx was examined before operation to assure preoperative normality. After one lobe of the thyroid was completely removed, the operation was interrupted for a moment while a laryngoscopic examination was made to see whether the corresponding vocal cord was functioning normally. In all but one of the forty-five operations to date, the laryngeal nerve of the side first operated on was uninjured, which permitted the safe removal of the other lobe. Even if the other recurrent laryngeal nerve is injured, no dangerous consequences will occur, for paralysis of one vocal cord is not attended by serious complications. In one case, the cord was paralyzed on the side first operated on. On that account the operation was terminated at this point. Since this operation was performed recently it is not yet possible to know whether the nerve will regain its function and so permit accomplishment of the second stage of the operation. In any case in which one nerve is permanently injured, the second stage will not be done because of the possibility, however slight, of producing the serious consequences of bilateral paralysis of the vocal cords. In all cases, laryngoscopic examination was done postoperatively within thirty-six hours, in order that disturbed function might be studied during the period of convalescence.

I believe that laryngoscopic examination is of the greatest importance after removal of one lobe of the thyroid, regardless of the type of anesthesia used. It may be thought that local anesthesia offers the possibility of testing injury to the vocal cords by noting changes in the voice during operation. Such is not the case, however. I have observed several patients with paralysis of one cord without any apparent change in the voice. False reliance on changes in the voice as evidence of unilateral injury to the vocal cords is certain to result in unfortunate consequences.

Of forty-five patients, seven acquired unilateral paralysis of the vocal cords which has so far remained permanent. Bilateral paralysis of the vocal cords has not occurred. In the seven cases, the left cord was affected six times; the right cord, once. In three patients, unilateral paralysis of the vocal cords was temporary; one cord returned to normal in forty-eight hours, and two others after several months. Still another of the original seven patients is showing signs of beginning motion in the vocal cord which may return to normal. In one of these patients marked stridor developed, necessitating a tracheotomy postoperatively. The paralysis disappeared after forty-eight hours, permitting removal of the tracheotomy tube. It is interesting to note the value of laryngoscopic observation in this patient during the operation. After the first lobe of the thyroid had been removed, laryngoscopic examination showed the right cord to be normal in function. The operation was continued on the left side. Immediately after operation stridor developed, and examination revealed both cords to be immobile in the median line. This was somewhat disconcerting, for direct observation had shown

the right side to be normal. Tracheotomy was done, however, with relief from the stridor. A delayed effect of manipulation of the nerve or edema after closure of the operative wound causing pressure on the nerve presumably had occurred. The next day the right cord began to show motion, and at the end of forty-eight hours complete function had returned, permitting removal of the tracheotomy tube. At present, the right cord is normal, but the left cord remains in the median line.

The most striking observation was that in all but one patient the paralyzed cords were in the median line in the position of abductor

Data on Patients with Unilateral Paralysis of the Vocal Cords

Name	Type of Case	Date of Operation	Postoperative Paralysis	Position of Cord	Voice Change	Progress
W. B.	Congestive heart failure	3/24/33	Left recurrent	Median line	Slightly thick	Cord still in median position
C. C.	Congestive heart failure	3/23/33	Left recurrent	Median line	Normal	October 11: cord returned to normal
W. F.	Congestive heart failure	4/ 7/33	Left recurrent	Median line	Hoarse	Died four days postoperatively; edema of lungs ?
L. B.	Congestive heart failure	4/17/33	Left recurrent	Median line	Normal	September: cord still in median line
W. Mc.	Asthma ?	6/ 6/33	Right recurrent	Median line	Somewhat hoarse	Median line ?
F. F.	Asthma	7/ 3/33	Left recurrent	Median line	Normal	September: cord normal
W. B.	Arteriosclerosis, congestive heart	7/ 6/33	Left recurrent	Median line		
J. T.	Hypertension, congestive heart	7/25/33	Left recurrent	Median line		
L. M.	Congestive heart failure, rheumatism	8/23/33	Left recurrent	Median line	Apparently normal	August 25: right cord returned to normal; tracheotomy tube removed; left, median line
S. K.	Lymphatic leukemia	September	Right recurrent	Partial paralysis	Hoarse	Right cord now in median line; voice clearer

paralysis. This is not a new observation, for it has been noted before by New and Childrey,[4] is found in old editions of Gray's "Anatomy" and is the basis of Semon's law. Since the recurrent laryngeal nerves are the main supply for both abduction and adduction, it is difficult to understand why the cord should not assume the cadaveric position if the nerve is injured below the point of entrance into the larynx. Many theoretical explanations are offered, but none seem capable of proof. The explanation, according to Semon's law, that the abductors lose their excitability first, is only a partial explanation, because eventually the cord should also show adductor paralysis and arrive at the cadaveric

4. New, G., and Childrey, J. H.: Paralysis of the Vocal Cords: A Study of Two Hundred and Seventeen Medical Cases, Arch. Otolaryng. **16**:143 (Aug.) 1932.

position. This it does not do, according to my observation as well as that of many others. The presumption is therefore raised that there is another innervation for the adductors that the abductors do not have. The only other possible nerve supply is the superior laryngeal nerve which supplies the cricothyroid and arytenoid muscle. The arytenoideus, although a small muscle, has crossed fibers, some of which are inserted into the opposite arytenoid and derive innervation from the opposite nerve. This serves to explain the presence of added innervation to the adductors. It would seem possible to evaluate through some experimental evidence the innervation of the superior laryngeal nerve, and the accessory adduction through the crossed fibers of the arytenoids.

Lemere [5] recently showed that this might be possible, although I have not as yet succeeded in substantiating Lemere's work; I am making further studies along these and other lines, bearing on the interrelationship between the intrinsic muscles and nerves of the larynx.

NOTE.—Since this article was submitted for publication, all but three of the paralyzed nerves have fully recovered their function.

SUMMARY

1. Observation of the vocal cords was made in a series of forty-five cases in which total ablation of the thyroid gland was accomplished, according to the technic of Berlin, for the treatment of angina pectoris and congestive heart failure.

2. Laryngoscopic observation in these cases was made before, during and after operation to note disturbed function of the vocal cords. In seven of these cases unilateral paralysis of the recurrent laryngeal nerves developed. In three the disturbance was temporary. In all but one of these cases the cords remained in the position of abductor paralysis in the median line, and only one assumed another position which, although not in the median line, could not be said to be the cadaveric position. Later this cord also appeared in the median line.

3. In practically all of these cases the spoken voice was unaltered when one vocal cord was paralyzed, so that the voice test could not be used as a test in place of direct laryngoscopic observation. The danger of false reliance on the voice test as evidence of unilateral paralysis of the nerve is pointed out.

4. The importance of direct laryngoscopic examination after removal of one lobe of the thyroid as a positive means of preventing bilateral paralyses of the vocal cords is emphasized.

5. Lemere, F.: Innervation of the Larynx: III. Experimental Paralysis of the Laryngeal Nerve, Arch. Otolaryng. **18**:413 (Oct.) 1933.

Clinical Notes

OXYGEN THERAPY IN ACUTE RESPIRATORY OBSTRUCTION IN CHILDREN

V. K. Hart, M.D., and S. W. Davis, M.D., Charlotte, N. C.

This is a brief supplementary report to our original paper.[1] In the past twelve months we have had occasion to make additional observations which we believe may be helpful to those interested.

Clinical observations of any therapy are not complete until failures as well as successes are recorded. Only by both can one properly evaluate the therapy.

A priori we shall discuss some of the clinical limitations of oxygen therapy and the apparent reasons thereof.

REPORT OF CASES

Case 1.—A white boy, aged 17 months, was admitted to the hospital on Oct. 7, 1932, with a history of having choked on a foreign body of undetermined origin earlier in the day.

Examination showed marked diminution of breath sounds over both lungs and tracheal and epigastric tugging. Because of the emergency, immediate bronchoscopy was performed without anesthesia, a 4 mm. scope being used. A large foreign body was seen at the bifurcation, and was seized with forward grasping forceps. Some trouble was encountered in getting the foreign body by the cords; it proved to be a bean. The time required for the procedure was four minutes.

The child did well for the next ten hours, and then marked stridor began to develop. He was placed under a Roth-Barach oxygen tent. An oxygen tension of from 40 to 50 per cent was maintained. Nevertheless, he continued to tug and was restless and cyanotic.

A few hours later it was necessary to remove the patient from the tent and carry out a rapid tracheotomy under local anesthesia. The dyspnea was not relieved until after a catheter had been inserted into the trachea to the bifurcation and a large quantity of thick yellow pus evacuated. A no. 1 Jackson tube was placed in situ.

Comment.—Both the trachea and the bronchi were filled with pus; therefore, the increased amount of oxygen was not sufficient to compensate for the marked decrease in the air pathways due to the accumulation of pus. It would seem that it would be better in such a case to proceed immediately with tracheotomy.

Case 2.—A boy, aged 8 months, was admitted to the hospital on March 17, 1933, with a history of having choked on a piece of celluloid. Some one, in attempting to evacuate it, had stuck his fingers down the patient's throat.

Examination showed a somewhat cyanotic baby with inspiratory stridor accompanied by tracheal and epigastric tugging. Immediate direct laryngoscopy was

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From the Charlotte Eye, Ear and Throat Hospital.

The oxygen therapy was administered by Dr. S. W. Davis.

1. Hart, V. K., and Davis, S. W.: Oxygen Tent in Postbronchoscopic Care of Children, Arch. Otolaryng. **16**:526 (Oct.) 1932.

performed without anesthesia. There was considerable edema of both arytenoid cartilages (due to trauma by the fingers?). In view of the clinical history and picture, it was thought best to look for a foreign body in the trachea. A small 3.5 mm. bronchoscope was therefore passed. No foreign body was seen in either the trachea or the bronchi. The time required for the procedure was two minutes. (A piece of celluloid was recovered from the stool the next day.)

Stridor steadily increased, and the child was placed under an oxygen tent several hours later. The symptoms were somewhat ameliorated. Ten hours later the stridor became worse, and the child collapsed in the tent. A very rapid intubation was done at the bedside, a no. 1 O'Dwyer tube being used. The child was revived, and was again placed under the tent for twenty-four hours and then removed. For five days the condition ran the course of an acute infection. Then the temperature approached normal, and the tube was gently removed. Some stridor promptly returned, and the patient was placed under an oxygen tent, an oxygen tension of from 40 to 50 per cent being maintained. He became comfortable, and forty-eight hours later we were able gradually to reduce the concentration of oxygen and remove him from the tent. Uneventful convalescence followed.

Comment.—There are several pertinent interesting observations. In the first place, intubation probably saved this child's life whereas tracheotomy might have been fatal. It is well recognized that babies do not tolerate surgical shock as well as older children. Of course, tracheotomy might have been performed earlier, before the acute asphyxia threatened. Even had this been done leisurely, with a bronchoscope in place if necessary, the element of shock must be considered. In our experience, the less children under 1 year of age are handled surgically, the better. The oxygen tent was of unquestioned value in extubating the child successfully and in avoiding otherwise certain tracheotomy. It has always been our practice never to leave an intubation tube in place for more than five or six days.[2] If at the end of that time extubation cannot be carried out successfully, we have heretofore put the larynx at rest by tracheotomy. By such a procedure, laryngeal stenosis is circumvented. In this case we were probably dealing with very acute nonspecific laryngitis secondary to trauma.

CASE 3.—A boy, aged 11 months, was admitted to the hospital with a condition diagnosed as diphtheria. Twenty thousands units of diphtheria antitoxin had been administered by the pediatrician prior to admission.

Examination showed a well developed baby, with cyanosis, audible inspiratory stridor and tracheal and epigastric tugging. Without anesthesia, direct laryngoscopy was performed. A pale, markedly edematous larynx was seen from which some thick pus was aspirated. Smears and cultures were made direct from the larynx. (A later report showed staphylococci; there were no Klebs-Löffler organisms.)

Immediate intubation was carried out with a no. 1 O'Dwyer tube, with complete relief of symptoms. Extubation was not attempted until six days later because of the continued febrile evidence of acute infection. Marked stridor immediately recurred. The child was then placed under an oxygen tent. Stridor and dyspnea continued, necessitating the quick reintroduction of the intubation tube one hour later. Tracheotomy was then immediately carried out under local anesthesia; a no. 1 Jackson tube was placed in situ and the intubation tube withdrawn. We were able to decannulate eight days later. The child fully recovered.

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2. Hart, V. K.: Laryngeal Diphtheria, Ann. Otol., Rhin. & Laryng. **39**:636 (June) 1930.

Comment.—Here again we might be criticized for not performing tracheotomy immediately. However, particularly when the obstruction is supraglottic, we believe that intubation should be carried out first. The child was in a state of shock. Further shock was avoided, and the child put at rest. Moreover, in acute nonspecific infections of the upper respiratory tract troublesome drying of the secretions is apt to occur posttracheotomically, particularly in the acute stage.

Why was oxygen therapy insufficient? Probably because the laryngeal space was so narrowed that even the increased oxygen tension did not compensate for the markedly diminished airway.

GENERAL COMMENT

For purposes of discussion, we analyzed fifty bronchoscopies performed on children during the same period of time represented by the cases reported. The ages varied from 8 months to 11 years. Only three children were more than 5 years of age. Foreign bodies were removed from the tracheobronchial tree of twenty-five children. The other twenty-five were examined for various reasons, viz., asthma, suppuration of the lung, unexplained roentgenographic findings in the chest and other conditions. In only three children, all with cases of foreign body, did evidence of respiratory obstruction supervene. Two of these cases have been reported. Postbronchoscopic tracheotomy was performed in one other case because funds were not available for oxygen therapy. In two other cases of foreign body, tracheotomy was carried out at the time of bronchoscopy for reasons discussion of which is not pertinent.

When oxygen therapy is used, we have found that careful attention must be paid to the control of humidity under the tent. The ideal relative humidity should be not less than 40 per cent or greater than 55 per cent for the obvious reason that a humidity below 40 per cent has a tendency to dehydrate the mucous membranes with an irritant effect, whereas a humidity above 55 per cent is too depressing systemically.

CONCLUSIONS

1. With the accumulation of large amounts of pus in the trachea, in the bronchi, or in both, tracheotomy with frequent aspiration of secretion is probably the method of choice (case 1).

2. We believe that oxygen therapy is a valuable adjunct in the treatment of obstruction of the upper respiratory tract (case 2).

3. In a pure laryngeal obstruction, oxygen therapy is successful only if the airway is not too narrowed. In marked or essentially complete atresia, some form of operative intervention must be used (case 3).

INSTRUMENTS FOR RADICAL OPERATIONS ON THE SINUSES

ANDREW A. LOVE, M.D., LOS ANGELES

The instruments herewith presented are for use in radical operations on the sinuses, particularly the Caldwell-Luc operation.

Instrument 1 in figure 1 is a periosteal elevator. It is light and easily handled and may be used to good advantage in a Caldwell-Luc operation or an external operation on the frontal or ethmoid sinuses or in an antrotomy on the mastoid.

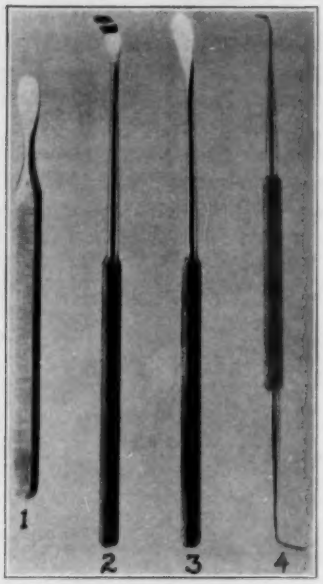

Fig. 1.—The periosteal elevator no. 1 is 15 cm. long and the blade 10 mm. wide. Instruments 2, 3 and 4 are 18 cm. long. The blade of instruments 2 and 3 is 9 mm. wide.

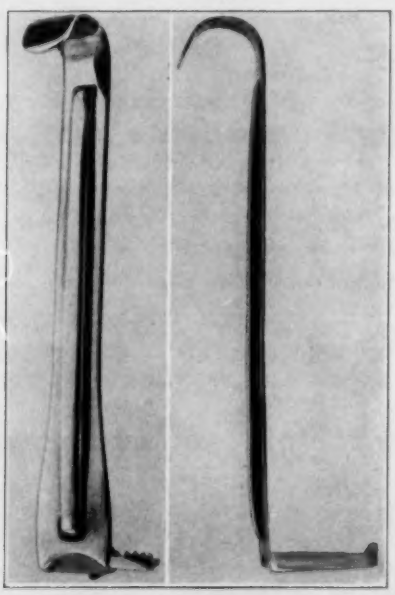

Fig. 2.—Two views of the retractor. It is 15 cm. long over all and 19 mm. wide at the tissue-grasping end. The serrations at this end are fairly sharp, so that when once placed it will not slip and have to be replaced from time to time, thus unduly traumatizing the tissue.

In performing a Caldwell-Luc operation the majority of operators now use the nearly vertical incision extending from high in the middle of the canine fossa to a point just above the first bicuspid tooth. After the periosteum has been elevated over a sufficiently large area, the retractor shown in figure 2 is placed with the teeth under the periosteum of the upper part of the incised tissue, thus holding the tissues well back on each side and sufficiently high to permit of making an opening of desired size into the antrum. The retractor is held by a nurse standing behind the patient. In making the vertical incision there is minimum injury to the nerves of that region. To make an opening through the canine fossa and yet not break the soft tissue lining of the sinus, a small mastoid curet (Spratt model preferred) is placed with the cup against the bone in the midportion of the fossa, and, exerting moderate pressure, the handle is rotated in such a way that a piece of bone is removed. A larger curet is then used and the opening widened until a piece of bone about 0.5 cm. in diameter has been removed. The curet must be sharp and used to the best advantage to do this, but a little practice will bring the desired results.

The small end of instrument 4 (fig. 1) is then used to loosen the lining around the periphery of the opening first, and it may be loosened further with the large end. After the lining has been separated a few millimeters from the periphery of the opening, the bone may be taken away with a Kerrison punch or one similar to it. By continuing this procedure, an opening of the desired dimension and placement may be made in the bony wall of the canine fossa without breaking or damaging the lining of the antrum. The advantage of this lies in the ease and thoroughness with which the rest of the lining may be peeled out from this point on.

By the use of the large end of instrument 4 and instruments 2 and 3, the lining may be entirely separated from the antral wall, and if care is exercised and the lining is not completely degenerated and too friable, it may be removed in one piece.

Instruments 2 and 3 are similar to those designed by Dr. Sewall for the same purpose some years ago. All were made for me by V. Mueller & Co.

Abstracts from Current Literature

Ear

A Case of Spontaneous Nystagmus Directed Alternately to the Right and to the Left. Buys, J. de neurol. et de psychiat. **32**:715 (Oct.) 1932.

The author reports the case of a patient, aged 49, who had diminished vision and dizziness, which was spontaneous or induced by abrupt movements. This was accompanied by slight nausea. The general health of the patient was not good. He had had malaria and a condition associated with hematuria. He had two children, both of whom were well. There was a nystagmus which was directed alternately to the right and to the left for periods of from one to two minutes, each period being separated from the following one by an interval of five seconds. It was not associated with the pulse or modified by sudden movements or positions of the head. The attacks began first with a slight movement, which progressed to great intensity and then diminished to entire disappearance. During the rest period, lateral rotation of the eyes would induce a nystagmus. In the Romberg test the patient tended to fall to the side away from the nystagmus, and in walking with the eyes closed, he tended to fall away from the nystagmus. There was an apparent deafness on the left. There were no changes in the reflexes or in sensation; there was no ataxia; the Wassermann test was weakly positive. Buys believes that only two similar cases have been reported. He states that if the centers for nystagmus are antagonistic and constantly stimulated, one after the other, on occasion, by habitual movements, and if one concedes that tone is modified for exchanges of energy, it is not impossible to admit that the alternation might be the result of permanent excitation. The only possible source of excitation is that which is the result of an old otitis.

Waggoner, Ann Arbor, Mich. [Arch. Neurol. & Psychiat.]

High Frequency Sound Waves in the Treatment of Chronic Baryecoia. O. Voss, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **135**:258 (July 14) 1933.

After his first year's experience with Mülwert's high frequency sound wave apparatus for the treatment of baryecoia, Voss reported a marked improvement in hearing of the whispered voice in from 14 to 19 per cent of the cases and of conversation in 30 per cent, while many other cases exhibited a less marked improvement. Moreover, the lower tone limit was often lowered and the upper tone limit occasionally raised. He now reports those cases (of the 400 since observed) in which the most striking results were obtained. The only difference noticed since the first report is that the upper tone limit is extended as frequently as the lower. The cases comprise instances of otosclerosis, presbycusis and hereditary degenerative or congenital syphilitic labyrinthine baryecoia. Some of them showed temporary and others permanent improvement. The tinnitus was decreased in many cases. The various theories as to the mode of action of this therapy are discussed.

Editor's Abstract.

Roentgenology in Gradenigo's Syndrome: Report of a Case. H. Epstein, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **135**:351 (July 22) 1933.

Epstein examined a child seven weeks after the onset of acute otitis media which was complicated in the third week by the appearance of violent headaches in the frontotemporal region, radiating to the eye, and occasional vomiting. At the time of examination no clinical manifestations resembling Gradenigo's syndrome remained, but roentgenographically the apex of the petrous bone was lacking and a large defect was visible in its place. These observations, together with the anamnesis, indicated that the otitis had been complicated by Gradenigo's syndrome.

The otitis healed after a normal evolution and without surgical intervention. In a roentgenogram taken one year later, the normal configuration of the apex of the petrosa was again visible. A small zone of lesser density appeared over the porus acusticus internus. The author thinks that the defect in the apex of the petrosa may be regarded as a decalcification which probably resulted from the inflammatory hyperemia in the spaces of the middle ear or started from the roentgenologically demonstrated zone of lesser density in the porus acusticus internus. He stresses the discrepancy between the roentgenologic symptoms and the absence of subjective symptoms at the time of examination. He recommends taking roentgenograms of the temporal bone in every case of acute otitis media lasting more than three weeks. Three exposures should be made on the diseased side—one according to Schüller, one according to Mayer and one according to Stenvers (especially suitable for the apex of the petrous bone)—and one control exposure should be made on the healthy side. EDITOR'S ABSTRACT.

ROENTGEN DIAGNOSIS OF CHRONIC DISEASE OF THE TEMPORAL BONE. G. B. FOMIN and S. I. WULFSON, Monatschr. f. Ohrenh. **67**:969 (Aug.) 1933.

Fomin and Wulfson state that roentgenograms of the temporal bone can give a complete picture of its structure, its anatomicotopographic relations and the nature and extent of the disease process affecting it, thereby permitting a more accurate diagnosis of the form of otitis and determining the choice of surgical intervention. Two methods should be employed; the authors suggest starting with Sonnenkalb's method and supplementing it with one of the other well known methods. In 91 per cent of all cases of chronic otitis eburnation of the mastoid process was found. In 92 per cent of 192 cases in which surgical intervention was undertaken the roentgenologic observations were confirmed at operation. Roentgen diagnosis is especially important in cholesteatoma, which may evolve silently and attack the labyrinth, sigmoid sinus and neighboring structures. The enlargement of the attic, antrum and periantral space by erosion of the lateral wall of the attic and the superoposterior wall of the auditory meatus can be seen in the roentgenogram in a zone of lesser density at the inner edge of the external meatus. Sharp contours denote a dry cholesteatoma; irregular contours denote the presence of pus and necrotic products. In tuberculosis a widening of the aditus with atrophy of the temporal bone is seen. In cavities not characteristic of cholesteatoma, malignant tumors are to be considered. Roentgenography also is valuable in showing the exact course of the large blood vessels, knowledge of which is necessary for the avoidance of injury to the sigmoid sinus during operation if its location is pathologically altered (which is frequently the case in sclerotic mastoid antrums). Isolated pneumatic cells which may contain pus but are separated from the main disease focus by apparently normal bone are also demonstrated in roentgenograms.

EDITOR'S ABSTRACT.

TUBERCULOSIS OF THE MIDDLE EAR. H. ASSHEUER, Ztschr. f. Hals-, Nasen- u. Ohrenh. **33**:322 (July 8) 1933.

Assheuer discusses the etiology, pathogenesis, symptomatology and therapy of tuberculosis of the middle ear on the basis of a study of the literature and of twenty-six cases observed at his clinic. He lists the clinical symptoms suggestive of primary and secondary tuberculosis of the middle ear. Definite conclusions as to the specificity of the otitis cannot be made from the clinical picture, and confirmation of the diagnosis of tuberculous otitis must be sought in bacteriologic examinations of the discharge, in biopsy, in inoculation of animals with secretions or granulations or in the focus reaction (*Herdreaktion*). The focus reaction consists in the appearance of hyperemia of the tympanic membrane and possible exacerbation of the otitic symptoms simultaneously with the cutaneous and general reaction to the subcutaneous injection of tuberculin. The prognosis is favorable as to life but not as to cure; it depends, in the first place, on immunologic considerations and, in the second place, on therapy. Therapy must build up general

resistance as well as treat the local symptoms. If the otitis is the main tuberculous focus, or if it is an old caseous focus continually pouring toxins into the body, operation is justified; if it is one of several equally dangerous foci, or if it is benign while other active foci are present, operation is contraindicated. Local heliotherapy may be tried before operation if the diagnosis is certain; if not, it is recommended for postoperative treatment. EDITOR'S ABSTRACT.

ROENTGEN EXAMINATION OF THE LABYRINTH IN CHRONIC OTITIS. L. KRAUS, Ztschr. f. Hals-, Nasen- u. Ohrenh. **33**:343 (July 8) 1933.

Kraus thinks that in chronic otitis roentgenograms of the labyrinth may, under certain conditions, be more instructive than the clinical symptoms, as they often show the direct pathologic development of the disease. The sequestrating form of labyrinthitis is most readily demonstrable. The ossifying form also gives clear pictures. Certain results of otitis interna can be recognized only roentgenographically. After radical operation sclerosis of the labyrinth is often observed. At present, nothing definite can be said of the roentgenographic changes in otosclerosis, but this may merely require time, and the same may be true of Ménière's syndrome and of deafness after various forms of meningitis.

EDITOR'S ABSTRACT.

QUANTITATIVE STUDIES OF POSTROTATORY NYSTAGMUS. F. WOLETZ, Ztschr. f. Hals-, Nasen- u. Ohrenh. **33**:476 (Sept. 4) 1933.

Woletz studied postrotatory nystagmus in fourteen normal persons according to the method of Fischer, using the electric rotary chair of Tönnies. With the present clinical method the angular speed increases quickly from 0 to 180 degrees; a uniform speed of rotation is maintained for twenty seconds, and then the rotation is rapidly arrested. The initial acceleration and terminal retardation are assumed to be equal, but this is not achieved in practice. With the new method three minutes are required to bring the speed of rotation to 180 degrees, the angular acceleration remaining below the threshold for vestibular stimuli. After a speed of 180 degrees per second has been maintained for any desired period, the rotation is rapidly arrested. With the clinical method, two opposite stimuli succeed each other within a short interval; with the new method, only one, the terminal retardation. After the arrest of rotation so-called first postrotatory nystagmus, with the rapid component in the direction opposite to that of the rotation, develops. This has an average duration of twenty-eight seconds and an average of forty-eight movements, giving a frequency of 1.6. There are great individual differences. There is usually a considerable difference in the duration and number of movements produced by rotation to the left and by that to the right. A striking personal variation was observed at different test periods, which must be due to the disposition of the central nervous system and which shows the unreliability of a single test. The first nystagmus is followed by a pause of an average duration of fifteen seconds. The pause also varies with the direction of the rotation and at different test periods. Second postrotatory nystagmus, which is rarely present in the clinical rotatory test, occurred in all the subjects. The movements of this nystagmus are much smaller and are frequently grouped; its average duration is sixty seconds, with an average of thirty-seven beats. The individual variations are greater than in the first nystagmus. The personal differences in reactions at different test periods are unusually large. The difference in reactions between rotation to the right and that to left is also greater than in the first postrotatory nystagmus. This is probably due to asymmetry of the central nervous system. In 10 per cent of the tests the second rotatory nystagmus was followed by further nystagmus rhythms, with change of direction in some cases. The regular phases which characterize postrotatory nystagmus must be central nervous rhythms. The author considers this procedure the method of choice for testing postrotatory nystagmus.

EDITOR'S ABSTRACT.

Pharynx

THE END-RESULTS OF THE TONSIL AND ADENOID OPERATION IN CHILDHOOD AND ADOLESCENCE. J. ALISON GLOVER and JOYCE WILSON, Brit. M. J. **2**:506 (Sept. 10) 1932.

This article is a statistical study comparing the histories of adults of the present day who have not been tonsillectomized with those of children who have been tonsillectomized. The deductions are not conclusive and might be classed largely as impressions.

ROYSTER, University, Va. [AM. J. DIS. CHILD.]

ROENTGEN TREATMENT OF RECURRENT INFLAMMATION OF THE NASOPHARYNX. R. NIEMEYER, Monatschr. f. Kinderh. **58**:439 (Aug.) 1933.

Fifty-four children with severe recurrent infections of the tonsils and lymphatic tissue of the nasopharynx were given roentgen treatment. Two thirds of them were free from recurrence for two and a half years. In the remaining one third the infections which developed were much milder than previously. The general health of the children was also improved.

GERSTLEY, Chicago. [AM. J. DIS. CHILD.]

THE HISTOLOGIC PICTURE OF RHEUMATIC FEVER: X. THE UPPER AIR AND FOOD PASSAGES IN RHEUMATISM. D. SARAFOFF, Virchows Arch. f. path. Anat. **286**:314, 1932.

In seven unselected cases of definite rheumatic disease in patients from 5 to 28 years of age which have been reported by Klinge, the tissues of the organs of the neck were studied in serial sections. Rheumatic lesions, such as circumscribed swelling of the matrix of the connective tissue, granulomas containing varying quantities of cells and fresh or old scars, were found in six of these cases. These lesions were located below the mucous membranes of the upper air passages, within the exterior and interior muscles of the larynx, between the muscle fibers of the pharynx, in the muscle layers of the esophagus, in the capsule of the thyroid gland, in the peritracheal and periesophageal tissue and in other places. The tonsils and adenoids failed to reveal any changes typical of rheumatic disease, in contradistinction to the peritonsillar tissue, which was markedly involved in four of the seven cases. In the remaining three cases, no lesion could be found in the peritonsillar tissue. No conclusions could be drawn as to a special portal of entry of the rheumatic virus, since the lesions showed various distribution in the different cases. There is no evidence which would indicate that the tonsillar tissue is the sole portal of entry, since signs of nonspecific inflammation were found in the mucous membranes of the pharynx and larynx.

SCHOENTHAL, New York. [AM. J. DIS. CHILD.]

THE HISTOLOGIC PICTURE OF RHEUMATIC FEVER: XI. FINDINGS IN TONSILS REMOVED BY OPERATION. F. KLINGE, Virchows Arch. f. path. Anat. **286**: 333, 1932.

Serial examinations were made of the tonsils of two patients, one a man, aged 20, and the other a boy, aged 11 years, who had suffered from attacks of acute rheumatic fever for three weeks and five months, respectively, prior to the removal of the tonsils. They revealed rheumatic infiltrations in the paratonsillar tissue in various stages of development, as described in previous papers.

In a third patient (27 years old), whose first attack of rheumatic fever occurred two months prior to tonsillectomy, a few small foci were found in the peritonsillar tissue.

In five other patients who gave a similar history, no specific rheumatic changes in the peritonsillar tissue could be detected.

SCHOENTHAL, New York. [AM. J. DIS. CHILD.]

ACNE VULGARIS AND CHRONIC ECZEMA CURED BY TONSILLECTOMY. A. GALTUNG, Norsk mag. f. lægevidensk. **94**:851 (Aug.) 1933.

The author describes three cases of acne vulgaris in which local treatment had given negative results. After tonsillectomy, however, the cutaneous lesions disappeared. The chronic tonsillitis in these patients had evidently caused the absorption of toxins and thus had produced an allergic condition of the skin.

TOVERUD, Oslo, Norway. [AM. J. DIS. CHILD.]

Larynx

A CLINICAL AND ANATOMICOPATHOLOGIC STUDY OF CONGENITAL LARYNGEAL CYSTS IN THE NEW-BORN. G. P. BELLOCQ and R. PERNOT, Rev. franç. de pédiat. **9**:236 (Feb.) 1933.

The cardinal signs are respiratory difficulty accompanied by cyanosis and stridor. There are always increased activity of the accessory muscles of respiration and retraction of the head. A diagnosis can be made by laryngoscopy. If the diagnosis can be made, a tracheotomy should be done at once, and the infant supported by the administration of oxygen and respiratory stimulants. While the authors' patient died, they believe that an earlier diagnosis and the performance of tracheotomy offer a chance of saving these infants.

SANFORD, Chicago. [AM. J. DIS. CHILD.]

DIAGNOSIS OF POSTENCEPHALITIC DISTURBANCES OF SPEECH. K. OKASHIMA, Monatschr. f. Ohrenh. **67**:1079 (Sept.) 1933.

In a patient observed by Okashima a disturbance of speech which was characterized primarily by spasms of the diaphragm and larynx during phonation was diagnosed as the first symptom of a postencephalitic extrapyramidal disease. The nature of the disturbance was recognized only by experimental phonetic analysis with the aid of a pneumograph.

EDITOR'S ABSTRACT.

Nose

INFECTION OF ACCESSORY SINUSES IN VITAMIN A DEFICIENCY: THE RÔLE OF CAROTENE IN INFECTION OF THE UPPER RESPIRATORY TRACT. R. G. TURNER and E. R. LOEW, J. Infect. Dis. **52**:102 (Jan.-Feb.) 1933.

Carotene therapy reduces the number of suppurative lesions of the upper respiratory tract of animals deprived of vitamin A. The incidence of bacteria in the nasal cavities and middle ear is decreased in animals fed carotene as compared to those having no source of vitamin A. Carotene protects rats which are deprived of vitamin A from bacterial invasion of the upper respiratory tract. Carotene in olive oil is stablized by the addition of hydroquinone.

TOOMEY, Cleveland. [AM. J. DIS. CHILD.]

SINUS INFECTION IN CHILDREN. G. S. OSINCUP, South. M. J. **26**:521 (June) 1933.

Patients with allergic sinus disease should be treated by employing cutaneous tests to determine the offending agent or agents. The author also recommends the giving of vaccine to such children and possibly a change of climate.

For the nonallergic patients, treatment is local, general and surgical.

Shrinkage of the nasal mucoa with ephedrine, followed by the use of one of the silver preparations, is useful for older children. Ephedrine, if used over a period of a few weeks, not only loses its effect but seems to become an irritant.

The author has had good success with the use of autogenous vaccine or even some of the better stock vaccines. The use of ultraviolet rays over the entire

body for a period of from two weeks to a month seems to be of the utmost value. In the diet, vitamins A and D should be abundantly represented.

Infected tonsils and adenoids must be removed, and any other foci of infection must be cleared up.

The author is not particularly in favor of a change of climate for these patients.

SCHLUTZ, Chicago. [AM. J. DIS. CHILD.]

HEADACHE AND PAIN IN INFLAMMATION OF NASAL SINUSES. HERBERT TILLEY, Brit. M. J. **1**:549 (April) 1933.

Pain is a frequent and sometimes the chief subjective symptom of chronic inflammation of the nasal sinuses. It may be generalized or confined to more or less restricted areas. It should be emphasized that the air cells on both sides may be in a state of chronic inflammation, even of the suppurative type, and yet there may be no history of diffuse or restricted pain in the head. The nasal sinuses, or air cells, and especially the ethmoid, frontal and sphenoid cavities, lie in such close relation to each other that it is unusual to find inflammation confined to any one of them. It is important to remember that the air cells, as well as the whole area of the face and most of the deeper structures of the head, derive their sensory innervation from the fifth nerve.

When pain happens to be a symptom of chronic inflammation of the nasal sinuses its cause is frequently the retention of pathologic secretions under tension. Pain or headache may be complained of, however, even when drainage is free, or following the natural opening of the sinus into the nasal cavity. This may be due to at least two causes: (1) the presence of a secondary chamber or loculus within the parent air cell and not freely discharging into it; (2) a hypersensitive condition of the inflamed mucous membrane of the sinus in a patient whose deep trigeminal nuclei have a low threshold of resistance to afferent impulses. The explanation of the phenomenon in the latter group may be that it results from a mild toxemia arising from the infected sinus or from some independent constitutional factor. In other instances headache or pain is produced by mere pressure on sensory nerves in the vicinity of the lesion.

Referred pains are common. It is Tilley's experience that pain is more likely to be of the localized or of the referred variety when only one sinus is affected, whereas a general headache is more common when more than one air cell is inflamed. In chronic antral inflammation, whether of dental or of intranasal origin, the pain will often be experienced in the area of the cheek or referred to a region corresponding to the supra-orbital foramen and the distribution of the supra-orbital nerve. In others, the pain may affect the whole of the corresponding side of the head. In chronic inflammation of the ethmoid air cells, pain is most often felt in the region bordering on the inner side of the orbit and at the root of the nose. From a diagnostic point of view, such pain can often be relieved immediately by the application of cocaine to the internal and external branches of the nasociliary nerves in the upper anterior regions of the nasal fossae. In other instances the pain may be felt over the vertex, or there may be a feeling of pressure in that locality.

The pain of frontal sinusitis is usually localized in and immediately around the region of the sinus and is definitely aggravated if pressure is applied upwardly and inwardly on the inner region of the floor of the air cell. In regard to this sinus, a "vacuum headache" may occur. It is due to the narrowing of the fronto-nasal duct leading from the sinus into the nasal cavity, brought about by the encroachment of the adjacent ethmoid cells through which the duct passes. Absorption of the air in the sinus brings about a vacuum and this induces a dull frontal headache. This is much increased by the sustained use of the eyes.

In involvement of the sphenoid sinus the most frequent location of pain is over the occiput; next in order is the vertex, and, occasionally, the region supplied by the supra-orbital nerve. If the vidian nerve becomes involved by inflammation of the outer wall of the sinus and neuritic changes reach Meckel's ganglion, the

sphenopalatine ganglion syndrome may result. There follow neuralgic pains in the supra-orbital, ocular, superior maxillary, mastoid and occipital regions, and in some cases they may extend to the shoulder blade, to the arm and even to the tips of the fingers. These symptoms may be accompanied by lacrimation and sneezing attacks. When the diagnosis has been established, injections into the ganglion will sometimes cure the pain. Another symptom of disease of the sphenoid sinus is pain over the corresponding mastoid region.

In his summary and conclusion Tilley emphasizes the importance of correct diagnosis in these conditions, especially when physical intervention is contemplated and required. The necessity for a complete examination is illustrated by brief reference to a patient who was considered for an operation because of chronic antral suppuration but who died on the following day in diabetic coma.

FERGUSON, Niagara Falls, N. Y. [ARCH. NEUROL. & PSYCHIAT.]

ETHMOIDITIS IN CHILDREN. J. C. MUNYO and A. IGLESIAS CASTELLANOS, Arch. urug. de med., cir. y especialid. **2**:390 (March) 1933.

Ethmoiditis may occur in children as early as the age of 1 year. The symptoms are irregular temperature, nasal discharge and frontal headache. Diagnosis is best made by roentgenograms. Generally the child should have a balanced diet rich in vitamin A. Vaccine give the best results. Twelve illustrative cases are described, with roentgenograms. SANFORD, Chicago. [AM. J. DIS. CHILD.]

RELATION OF NASAL POLYPI TO HYPERTROPHIC INFLAMMATION OF THE NASAL SINUSES. J. TREER, Monatschr. f. Ohrenh. **67**:1065 (Sept.) 1933.

In 307 cases of nasal polypus studied by Treer the maxillary sinus was completely normal, and in 20 per cent of the cases it exhibited only a light inflammation. This confirms Zuckerkandl's assertion that nasal polypi result from chronic inflammation of the nasal mucosa on the basis of predisposition. That inflammation of the nasal mucosa often extends to the sinuses is shown by the fact that a mucoid secretion was found in the maxillary sinus in from 15 to 37 per cent of the patients with chronic nasal catarrh. However, the presence of a severe hypertrophic inflammation of the maxillary sinus in 50 per cent of the cases of nasal polypus shows that there is a connection between this frequent form of inflammation and the nasal polypi. The hypertrophic inflammation of the accessory sinuses results from impeded drainage due mainly to the presence of nasal polypi. The change in the sinusal mucosa results from irritation produced by the stasis of the mucoid secretion of the sinuses. A severe hypertrophic inflammation of the accessory sinuses can increase the nasal catarrh and thereby favor the recurrence of nasal polypi. The development and cure of chronic and acute purulent and hypertrophic inflammatory processes of all the accessory sinuses are governed by the drainage conditions of the individual sinuses. EDITOR'S ABSTRACT.

DEGENERATIVE CHANGES OF THE NOSE IN ATROPHIC CONDITIONS. A. MINKOVSKY, Monatschr. f. Ohrenh. **67**:1104 (Sept.) 1933.

Minkovsky studied numerous microscopic nasal sections from cases of atrophic rhinitis which came to necropsy. He distinguishes two types of atrophy: (1) that in which degenerative changes of epithelial and glandular tissue predominate and (2) that in which cartilaginous changes predominate. He thinks that the first type of atrophy results from an exogenous irritation, whereas the second type is caused by endogenous factors which first bring about the resorption of cartilage and much later cause changes in the glandular and epithelial layers. The atrophy brought about through the degeneration of glandular and epithelial tissue has the more favorable prognosis, since these tissues have a greater capacity for regeneration than cartilage. In atrophy with cartilaginous degeneration the

prognosis is poor, as the epithelial and glandular apparatus will eventually lose its functional significance. Extreme dryness of the mucosa without signs of resorption of cartilage (rhinoscopically demonstrable change and decrease in the size of the concha) cannot be regarded as a sign of deeply penetrating process, as it may be limited to the superficial epithelial and glandular layers. If the dryness is associated with resorption of cartilage, severe atrophy exists. EDITOR'S ABSTRACT.

Miscellaneous

ALLERGY AS RELATED TO OTOLARYNGOLOGY AND PEDIATRICS. FRENCH K. HANSEL, J. Pediat. **3**:516 (Sept.) 1933.

In this review the author gives an analysis of the publications on allergy that is of interest to both the otolaryngologist and the pediatrician. Special emphasis is placed on the differentiation of allergic and infectious nasal conditions. Consideration must be given to the factors which indicate an allergic basis, such as the family history, the past history of allergic manifestations, the present symptoms, tests of the skin and examination of the blood for eosinophils. From the otolaryngologic standpoint, the following procedures are of the greatest value: rhinoscopic examination, nasal smears, roentgenologic examination of the sinuses and histologic study of the nasal and sinus tissues. In allergic rhinitis the nasal mucosa is usually pale, whereas in infectious rhinitis it is injected. Eosinophils are numerous in the nasal discharge of allergic persons, whereas pus cells predominate in the discharge of persons with infectious rhinitis.

LEMASTER, Evanston, Ill. [AM. J. DIS. CHILD.]

A CASE OF OSSEOUS FRAGILITY WITH CRANIAL DEFORMITY AND BLUE SCLERAE. J. ARLABOSSE, J. de radiol. et d'électrol. **15**:92 (Feb.) 1931.

Apert, in 1928, called attention to a heredofamilial condition the chief characteristics of which were: osseous fragility; deformity of the skull; laxity of the ligaments; blue sclerae; auditory disorders, and impairment of electric contractility of the muscles. Since that time several similar cases have been recorded in the literature. The author recently observed in a youth 19 years of age a marked roentgen permeability of the entire skeleton concomitant with deformity of the skull and with the presence of blue sclerae. It is interesting, however, that there were no fractures such as are usually observed in fragility of the bones (the patient indulged in active sports, such as football), and the auditory disorders, as well as the heredofamilial nature, were also absent. The case is placed in the group of osteopsathyrosis (fragility of the bones).

STULIK, Chicago. [AM. J. DIS. CHILD.]

NEURALGIA OF THE GLOSSOPHARYNGEAL NERVE. J. TERRACOL, Rev. d'oto-neuro-opht. **11**:161 (March) 1933.

Several months after hysterectomy for an ovarian cyst, a woman, aged 46, suffered with crises of pain in the lateral pharyngeal wall and the left ear. The crises increased in intensity and frequency and were accompanied by tinnitus, temporary decrease of acuity of hearing, occipital headache, pain on pressure over the exit of Arnold's nerve, exaggeration of the pharyngeal reflex and lowering of the right palatine arch. Nothing significant was discovered in the several examinations made, except that roentgenography disclosed an osteo-arthritis of the cervical spine. Rapid recovery followed appropriate therapy, chiefly diathermy.

The posterior cervical sympathetic syndrome was studied by Barré and Leiou. There are three clinical forms, depending on the three different localizations: (1) the superior syndrome (true posterior cervical sympathetic syndrome); (2) the middle syndrome, which is characterized by paresthesia, glossodynia, difficulties in

swallowing, muscular atrophy of the pharynx and laryngeal disturbances, and (3) the inferior syndrome, represented by painful amyotrophic and paralytic phenomena in the domain of the superior brachial plexus. The three forms merge into each other clinically and have a common anatomicopathologic basis: osteoarthritis of the cervical column. Most often the osteo-arthritic process involves the region of the spinal foramina. Terracol thinks that this process is the result of a broken physicochemical equilibrium in the colloids constituting the interstitial plasma. This equilibrium is the product of three principal factors: sanguine (composition and quality of the blood); circulatory (more or less rapid exchanges in the territory under consideration) and mechanical (pressure, traction and tangential movements). Most of the patients are demineralized, the trouble often appearing in women at the menopause or after castration. When there is loss of calcium, the blood takes its needed supply from the osseous system. The circulatory factor is most important. All the phenomena of ossification are ruled by the circulatory factor. The nutritional arteries of the cervical column are the dorsospinal branches, coming chiefly from the vertebral artery. No other important artery has so long an intra-osseous course. All osteo-arthropathies are the result of disturbed vasomotor innervation. The periarterial sympathetic seems to be the sole trophic nerve, and trophic phenomena must be considered as circulatory phenomena. Vasomotor disorders explain the symptoms and pathogenesis of the troubles observed. Narrowing of the spinal foramina is not a sufficient explanation. This disorder may be determined by disturbance of the vertebral nerve, which is the vasomotor organ of the vertebral artery. In the case reported the tinnitus and diminished hearing may be explained by a vasomotor disturbance of the vertebral artery, but the neuralgia must be attributed to the glossopharyngeal nerve. There is, therefore, an association of neuralgic and sympatheticalgic phenomena, easily explained by the frequent anastomoses of medullated and nonmedullated fibers.

DENNIS, Colorado Springs, Colo. [ARCH. NEUROL. & PSYCHIAT.]

EXPERIMENTAL DYSTROPHY OF UPPER RESPIRATORY TRACT. A. MINKOVSKY and E. G. MICHLIN, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **136**:177 (Sept. 21) 1933.

Minchovsky and Michlin compelled rabbits to smoke by inserting cigarets into especially constructed masks fastened onto the rabbits, and then studied the effect of the tobacco smoke on the upper respiratory passages. They found that an intensive action of the irritant (large doses) over a relatively short period produces a resorption of the cartilage of the nasal conchae, intensive degeneration of the epithelial covering, obliteration of the blood vessels, replacement of the glands, the cartilage and (in part) the bone by connective tissue, and degenerative changes of the laryngeal cartilages. The trachea appeared more resistant and was not much affected. In the rabbits that received smaller doses of tobacco over a longer period only the initial stages of degeneration of the nasal and laryngeal cartilages (and in one case tracheal cartilage) were observed and the changes of the epithelial covering were more superficial than in the other group. The epithelial and glandular changes did not parallel the cartilaginous changes, but in those cases in which high grade degeneration of the cartilage occurred, the epithelium was severely deformed and replaced by cornified squamous epithelium. In the rabbits which received the smallest doses over the longest periods, a moderate involvement of the epithelial and glandular tissue was seen, as well as a beginning of vascular atrophy, with an intact nasopharynx, larynx and trachea. The changes which occurred in the upper respiratory tract under the influence of the employed irritant were due to the dystrophy, which here assumed the form of degenerative atrophic processes. The degree of atrophy appears to depend on the maximal daily dosage of the irritant.

EDITOR'S ABSTRACT.

Society Transactions

GERMAN OTOLARYNGOLOGICAL SOCIETY

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ZEITSCHRIFT FÜR HALS-, NASEN- UND OHRENHEILKUNDE **34**:129, 1933

ABSTRACTED BY ALFRED LEWY, M.D.

FUNCTIONAL ANATOMY OF THE HUMAN TEMPORAL BONE. DR. LOEBELL, Marburg, and DR. NAUCK, Freiburg.

The temporal bones of 31 adults and 10 new-born infants were examined. The authors state that the mechanicofunctional architecture of the labyrinthine capsule has received little attention, former studies having dealt principally with the histologic structure. They have studied the temporal bone from the standpoint of its relation to its surroundings, viz., the dura, and of its relation to the skull as a whole. The adjacent layer of the dura appears as periosteum. In the posterior and middle fossae the surfaces are mainly perpendicular fissures or lines of cleavage. Similar fissures are demonstrable running in various directions in all parts of the bone. The authors describe these fissures in the labyrinthine capsule in particular, where they include the six predilection areas for otosclerosis described by O. Mayer as "spontaneous fractures."

HISTOGENESIS OF OTOSCLEROSIS. DR. LANGE, Leipzig.

After further consideration of the specimens presented by M. Weber and of his claims with regard to the relationship of otosclerosis and osteitis fibrosa Lange reiterates his former opinion (*Ztschr. f. Hals-, Nasen- u. Ohrenh.* **25**:1, 1930) that in otosclerosis the new bone is lamellar, in contrast to that in osteitis fibrosa which is fibrillar. Moreover, after further study of O. Mayer's claims that "spontaneous fractures" are the predilection sites for otosclerosis, he is still of the opinion that these supposed fractures are artefacts.

DEVELOPMENT OF FISSURES IN THE LABYRINTHINE CAPSULE. DR. ESCHWEILER, Leipzig.

Eschweiler undertook to produce experimentally the fissures which O. Mayer described as "spontaneous fractures" and believed to be of etiologic importance in otosclerosis. Eschweiler tried to determine by various technics whether or not they may be artefacts. Although avoiding every possible trauma in the handling of specimens he was unable to prevent their occurrence. Moreover, he was unable to produce them by pressure though he did produce fissures of a different type. This leaves them still unexplained. The author states that, like Witmaack, he failed to discover any biologic reaction in the region of these fissures, which speaks against their intravital development. The characteristic locations indicate that they are anatomic peculiarities rather than the results of mechanical causes, and their more frequent occurrence in older people, particularly in those with otosclerosis, suggests that they occur in inferior bone associated with metabolic disturbances. They do not resemble fissures described elsewhere in the skeleton.

OTOSCLEROSIS AND ALTERATION OF THE LABYRINTHINE CAPSULE. DR. WEBER, Leipzig.

Weber presents an abstract of a monograph which will be published later, describing the findings in 136 otosclerotic temporal bones from the collection of O. Mayer and Lange. The same areas were examined after staining with hema-

toxylin and eosin and by polarized light to demonstrate the fibrillar bone. Specimens were also stained by the Bielschowsky-Maresch silver method. After describing in detail his histologic observations, Weber concludes that otosclerosis is a disease of the labyrinthine capsule reaching its height in definite areas. It is unknown at present whether other parts of the skeleton are similarly involved. The youngest person in whose temporal bone he found the first step of bony change (the blue mantle of Manasse) was 5½ years old. He therefore concludes that otosclerosis itself is not, strictly speaking, hereditary, but that the tendency thereto is. [A specimen from a 7 month fetus is now on record. A. L.] This inferiority must lie in the fibrillar bone, which reaches maturity during the second year of life. In addition, there must be a local or general metabolic disturbance. Resorption of the normal bone in all instances must precede the deposit of lamellar bone in the otosclerotic area.

ALTERATIONS IN THE LABYRINTHINE CAPSULE OF THE RABBIT IN ACIDOSIS. DR. KRAINZ, Innsbruck.

Katase and Lang showed that acidosis induced by the injection of dextrose causes changes in the bones of rabbits identical with those occurring in rickets in human beings. Krainz has extended the investigation to the labyrinthine capsule and reports changes consisting of resorption of bone, with appearance of osteoclasts along the bony canals and the marrow spaces, followed by deposition of new bone and of noncalcified bone. These changes occur mostly in the fossa mastoidea in the region of the semicircular canals (not in the cochlear region) and principally in periosteal bone, but also in endochondral bone in prolonged experiments. The bony changes seem to appear in the labyrinthine capsule last, and here in specially selected areas.

RESULTS OF INJECTION OF PARATHORMONE IN RATS AND GUINEA-PIGS, WITH SPECIAL REFERENCE TO THE TEMPORAL BONE. DR. BARTH, Berlin.

Barth was able to demonstrate changes similar to those of osteodystrophia fibrosa which involved the temporal bone as well as other portions of the skeleton. The object of the experiments was to throw some light on otosclerosis. The results seem to show that the labyrinthine capsule is the most resistant of the bony structures, and yet in otosclerosis the labyrinth alone is involved. It would be interesting to observe whether or not in a normal environment recovery from the changes in the temporal bone would take place in the experimental animals.

EXPERIMENTAL OSTEODYSTROPHIA FIBROSA PRODUCED BY OVERDOSAGE OF VIOSTEROL AND ITS SIGNIFICANCE FOR OTOSCLEROSIS. DR. TOBECK, Göttingen.

Tobeck states that few efforts at experimental solution of the problem of otosclerosis have been made. [He mentions Witmaack's experiments with venous hyperemia but does not refer to Lewy's study entitled "Effect of Fluorine on the Bony Labyrinth of the Mouse." A. L.] It is now possible to influence even the bony labyrinth along with the rest of the skeleton by special feeding, by giving metabolic poisons and by injecting hormones of certain glands of internal secretion. The changes are of an osteodystrophic nature and are not typical of otosclerosis. Tobeck used viosterol in toxic doses in rabbits. The animals lived from three to one hundred and forty-eight days. Generalized osteodystrophic changes took place in most of them. In some the changes extended to the bony labyrinth. With these changes there were evidences of the presence of osteoblasts and of deposits of osteoid tissue. Tobeck realizes that these experimentally produced changes, while somewhat similar to those of otosclerosis, are not identical with them. He hopes, however, that some valuable suggestions as to a method of experimental approach may come from his results.

FUNCTION OF THE CUPULA IN THE AMPULLAE OF THE CANALS OF THE LABYRINTH. DR. STEINHAUSEN, Greifswald.

Steinhausen injected india ink into the horizontal labyrinthine canal of the live pike, which was then examined under magnification with and without stimulation. He succeeded in doing this with the hen also, but this report concerns the experiments on the pike. His observations show that in life the cupula fills the ampulla, so there can be no movement of the endolymph without displacing it. Since he could not test ampullar nerve stimulation directly by measuring the action currents, he did it indirectly by means of the induced ocular movements. By inserting a cannula into the canal he was able to move the endolymph and with it the cupula. The result showed that ocular movement was stimulated, and in the same direction, when the cupula was bent toward the utricle, i. e., stimulation of the left cupula caused a slow movement of the eyes to the right. If the stimulation was continued, there was a recovery movement to the left (horizontal nystagmus to the left). When the cupula was bent away from the utricle no movement of the eyes followed. These experiments support the Mach-Breuer-Brown theory.

THE LABYRINTH AND CIRCULATORY REACTIONS. DR. SEIFERTH, Köln, and DR. MARK, Breslau.

The authors look on the cardiac branch of the vagus nerve (depressor vagi) and the superior carotid plexus as regulators of blood pressure. When the head is laid back, the pulse is slowed and the blood pressure lowered. If one labyrinth is stimulated or one destroyed, this lowering of blood pressure on laying the head back takes place to a lesser degree. If both labyrinths are destroyed the reaction is markedly increased; i. e., the lowering of blood pressure is more marked and lasts longer than when the labyrinths are intact. These experiments indicate that the labyrinths inhibit the lowering of blood pressure caused by laying the head back. They also show that with the circulatory reaction caused by lowering of the head backward the irritability of the labyrinths is increased, as shown by increased frequency and intensity of the nystagmus.

EXPERIMENTAL TRAUMATIC SHOCK OF THE EQUILIBRATION APPARATUS IN ANIMALS. DR. GRAHE, Frankfort-on-Main.

Guinea-pigs enclosed in a container were dropped a distance of from 7 to 15 meters. They were immediately removed and tested for postural reflexes, progression reactions (lifting, toe-spreading, readiness to spring, muscle tremor) and turning reactions. They were then killed by bleeding, and autopsy was performed.

After-turning nystagmus was not affected. The only constant effects were in the progression reflexes, especially the lifting reaction and readiness to spring. Less markedly influenced were the postural reflexes of the head and the reactions of the extremities to stimulation of the labyrinths. The postural reflexes of the eyes were not disturbed.

Histologically there were isolated tiny bleedings and dilated vessels in the brain. There were no lesions in the labyrinth.

EFFECT OF ULTRA-ACOUSTIC SOUND WAVES ON THE DEAFENED EAR. DR. PERWITZSCHKY, Munich.

Ultra-acoustic sound waves are obtained from: (1) pipelike instruments (Galton's whistle, monochord, forks); (2) piezo-electric stimulation with crystalline quartz; (3) flow of alternating current through a magnetic field; (4) so-called magneto constriction.

The author analyzes from the standpoint of physics the waves produced by these various agencies and gives statistically the results that he obtained in treatment. Deafness showed practically no improvement except in a few types of cases (mixed deafness was improved in 17 per cent of the cases; deafness following radical operation, in 25 per cent; deafness from chronic otitis media, in 27 per cent,

and residual deafness, in 39 per cent). The results obtained for tinnitus were better, improvement being noted in 33 per cent of the cases of mixed deafness, in 40 per cent of those of otitis media, in 52 per cent of those of otosclerosis and in 75 per cent of those of inner ear deafness (3 of 4 cases).

DISCUSSION

During the discussion it transpired that one observer testing a number of patients with a faked instrument in order to determine the effect of suggestion obtained subjective improvement in 80 per cent, and the author admitted that the subjective improvement is not supported by careful objective tests in many cases. Frenzel believes that the effect of the ultra-acoustic waves is on the nervous system.

WHAT IS THE SIGNIFICANCE OF THE STENGER TEST? DR. LANGENBECK, Leipzig.

It is generally believed that electrically produced sound is better than that of tuning forks for the Stenger test because the tone can be continuous as desired, without decrement as with forks. Hinsberg uses reproduced speech instead of plain sound. Recent experience with a malingerer who refused to cooperate brought to light some of the inadequacies of the test. The Stenger test for the simulation of total unilateral deafness is based on the masking of sound in the good ear by the alleged deaf one. If one ear is very deaf and the other moderately so or normal, sound will be referred to the worse ear when the intensity on that side is increased above the difference; e. g., if the left ear is one hundred times as deaf as the right, increasing the intensity so that it is more than one hundred times as great in the left ear as in the right will cause the sound to be localized in the left ear. This difference in perception also varies in accordance with the source of the sound, whether a fork, an electrical device in the ear or a loud speaker. Speech is not as useful as simple tones, as the threshold for speech is variable because of the variable formants, and in general is higher than the threshold for simple tones. It is also possible for patients with tone islands insufficient for speech perception to be thought malingerers on the basis of the Stenger test if tones are used that they happen to have hearing for. On the other hand, a person severely but not totally deaf on one side may simulate total unilateral deafness without being discovered.

The author suggests a test in which the oto-audion is used. The hearing of the good ear is measured from C to C 5. The deaf ear is then tested for the same tones that are carried to the good ear. There is a constant ratio for the different pitches, which cannot be learned well enough to be simulated.

CHANGES IN THE COCHLEA IN HEREDITARY INNER EAR DEAFNESS. DR. ALBRECHT, Tübingen.

Albrecht presents preparations from two persons who had hereditary deformity of the cochlea. He also presents a genealogical tree to show that the deafness caused by these anomalies is a dominant characteristic, as distinguished from the sporadic type of deafness, which is a recessive characteristic. He states that mass statistics are of no value in determining this, careful genealogical research in individual cases being the only source of information.

COMPARATIVE NITROGEN CONTENT OF THE SECRETION FROM THE MIDDLE EAR IN ACUTE OTITIS MEDIA AND IN TUBOTYMPANIC CATARRH. DR. GOEDEL, Heidelberg.

Goedel cites reports in the literature and gives his technic in detail. Clinical diagnoses and bacterial findings are given. Some of the patients had malignant conditions of the nasopharynx. On the results of these examinations two classifications of otitis media could be established: (1) benign, uncomplicated forms in which the secretion was characterized by a low and a progressively decreasing

nitrogen content; (2) severe forms in which the secretion had a relatively high nitrogen content and an increasing tendency thereto.

The results of examination of the secretions in tubotympanic catarrh bespeak an inflammatory origin for them.

THROMBOSIS LIMITED TO THE JUGULAR BULB. DR. UFFENORDE, Marburg.

Uffenorde dwells on the difficulty of diagnosis. He reviews the literature and describes his case in detail but regrets that he is unable to clear up the principal difficulties.

A 36 year old woman suddenly began to suffer from headache, severe chills, pain in the throat and the ears and vomiting. The temperature was repeatedly 40 C. (104 F.). On the third day there was a discharge from the left ear, and two days later, from the right ear. The secretion was at first bloody and then purulent. The patient had nursed two members of her family who had scarlet fever, getting up on the third day after parturition for that purpose. There were no definite symptoms of involvement of the mastoids or the labyrinths. Immediate paracentesis was performed in both ears. In a few days severe sepsis and increased fever developed. The spinal fluid was under a pressure of 200 mm. but was otherwise normal. On the sixteenth day the spaces of the left middle ear were exenterated. There were bloody spots on the mastoid, scant pneumatization, swelling of the mucosa, little pus and no necrosis or sequestra. Meningitis developed, and streptococci were found in the spinal fluid. The patient died five days later.

Autopsy, in addition to the meningeal inflammation, showed: on the right side, closure of the perforation of the membrana tympani, evidences of renewed acute activity in the middle ear, thrombosis of the upper wall of the jugular bulb with no involvement of the sinus, dehiscences in the tympanic cells over the bulb and in the floor of the tympanum, and pus in the internal auditory meatus and the subarachnoid space; on the left side, dehiscences in the tympanic floor and pus in the subarachnoid space and the internal auditory meatus but no thrombosis.

After a long discussion of the difficulties of diagnosis Uffenorde concludes that when (and if) the diagnosis can be made, usually by excluding the lateral sinus at operation, he prefers the Piffl approach through the floor of the canal and the tympanic cavity. He states that in the present case the site of the thrombosis could not have been reached by the Voss or the Grunert technic.

THE STREIT OPERATIVE APPROACH TO THE PETROUS TIP IN THE GRADENIGO SYMPTOM COMPLEX: REPORT OF A CASE. DR. UNTERBERGER, Jena.

The incision into the soft parts begins 2 cm. above the auricle at its anterior border and then follows the helix and auricle downward around to the mastoid tip; another horizontal incision joins the first at the spine, extending backward toward the lambdoid suture; the temporal muscle is uncovered and its back portion freed, and the entire flap, including the auricle, is displaced down and forward. Exenteration of the mastoid and the middle ear is performed, the middle fossa being exposed by resection of the zygomatic root, enlargement of the upper and forward parts of the canal and partial resection of the squama. The tegmen tympani, the tegmen aditi and the tegmen antri are removed. The dura is separated from the anterior surface of the petrosa as far as the impressio trigemini, forward to the adhesions at the hiatus canalis facialis and backward to the tentorium cerebelli. Under protection of the author's dura spatula the dura is then lifted off the impressio trigemini, which may be a gutter, a special raspatory curet being used which, if it slips, impinges against the dura spatula (elevator).

The author's experience is that the first two steps of the operation are easily accomplished; the elevation of the dura, however, is somewhat difficult, and the elevation of the dural envelop of the impressio trigemini is extremely so. The depth of the impressio trigemini varies from 27 to 35 mm., according to the breadth of the skull, and visibility is not good in the depths of the pocket. Pre-

liminary tapping of spinal fluid decreases intracranial pressure and facilitates the operation, and if the subarachnoid space or the cisterna pontis (lateralis?) is accidentally opened this does no harm; on the contrary, the paralysis of the abducens nerve and the symptoms of trigeminal involvement are promptly relieved.

This operation is adequate for treatment of an extradural abscess in this locality. Moreover, if it is necessary to attack radically the petrous tip, this procedure furnishes a means of approach for a translabyrinthine operation from the anterior surface of the petrosa. The dura is retracted to make the eminentia arcuata as visible as possible, and the eminentia is removed, together with the entire group of semicircular canals; the labyrinth is opened from above by successive shavings of bone, stopping at the angle. If the chiseling is carried farther, the facial nerve is endangered at the geniculate ganglion, but the opening is a guide for further shaving parallel to the angle of the petrosa until the internal auditory canal is reached. Medial to this the petrous tip is entered by a few strokes, and any concealed abscess is drained.

CHICAGO LARYNGOLOGICAL AND OTOLOGICAL SOCIETY

Regular Meeting, Dec. 4, 1933

AUSTIN A. HAYDEN, M.D., *President, in the Chair*

NEUROCYTOMA ORIGINATING FROM THE RIGHT STELLATE GANGLION. DR. FRANCIS L. LEDERER.

My associates and I have come in contact with a number of cases of neurocytoma. This one is of interest because the tumor originated from the right stellate ganglion. The eye was enucleated because of a growth which was supposed to be a sarcoma of the orbit but which proved to be a neurocytoma. The material preserved in vitro shows the growth in the stellate ganglion and in the various parts of the body, such as the ribs, long bones, calvaria and ovaries, to which it metastasized.

The growth represents both the Hutchins and the Pepper type. This happens to demonstrate our usual experience. The primary tumor was in the right stellate ganglion, and the soft, furfuraceous metastatic mass was in the calvaria and involved the dura mater. Such tumors are often diagnosed as hematomas because there is frequently a history of trauma, and no doubt they have been mistaken for osteogenic round cell sarcoma, chloroma and scurvy. In this case the appearance of the calvaria is very characteristic. There were also metastases to the long bones and to the ovaries.

In most of the cases that are described in the literature the neurocytoma originated in the medulla of the left suprarenal gland, and the orbit on the same side was usually involved. The literature mentions orbital hemorrhage as the first sign, occurring before a tumor exists, but we have not seen this in the cases that we have observed early. Malignant growth in the suprarenal medulla is not considered especially unusual. Neurocytoma occurs most frequently in the region of the sympathetic nervous system. It grows rapidly and metastasizes before a diagnosis can be made. Neurocytoma occurs mainly in very young infants.

PRIMARY BRONCHIOGENIC CARCINOMA: INCIDENCE, PATHOGENESIS AND DIAGNOSIS. DR. HENRY C. SWEANY (by invitation).

In summarizing my remarks, I wish to emphasize only the most important points with regard to primary bronchiogenic carcinoma. First, the facts available do not justify the conclusion that there is a true increase in cancer of the lung. One should take hope rather that better diagnostic methods are revealing more

cancers than were detected in the past and that the chances of the patient's survival are therefore better than before.

Second, cancer of the lung is similar to cancer in other parts of the body in its origin from a basal, embryonic type of cell. This cell is the basal cell of the bronchial mucosa, which through some inherent derangement of the germ plasm fails to reproduce injured tissue according to its normal function and grows out in an anarchistic fashion, simulating all types of ancestral epithelial cells. The resulting tumor may be slow growing and circumscribed or infiltrating and metastasizing, depending on the type of the malignant cell, the age of the person, the amount of connective tissue and other factors.

Third, pulmonary carcinoma produces roentgenographic shadows and symptoms according to the type and the extent of the growth. In the earliest stage it usually produces only a local irritation leading to cough, with a mucoid sputum sometimes tinged with blood. At this stage the growth is too small to cast a roentgenographic shadow but may be seen by means of the bronchoscope. The circumscribed type usually is painless for a long time but casts a discrete shadow. It may cause cough and dyspnea by pressure and also give physical signs. The infiltrating type casts a hazy, indefinite shadow but produces bleeding, cough, early pain and distant metastases. The bronchoscopic view usually shows a variety of tumor formation in the bronchus or a fixed and woody bronchus, or both.

DISCUSSION

DR. ALLAN J. HRUBY: My associates and I have a large clinic in Chicago for treatment of diseases of the chest. We have felt that it depends largely on us as internists to make the diagnosis of bronchiogenic carcinoma in order that the patients may be given treatment early. I shall confine my remarks to some of the more important symptoms and the diagnosis.

In reviewing the literature and the 112 cases which we reported, exclusive of the cases that we observed at the Municipal Tuberculosis Sanitarium, we found that cough was most frequently the first symptom (in 6 cases). Next came pain (in 36 cases); next, dyspnea (in 14 cases), and last, hemorrhage (in about 5 cases). Cough as the earliest symptom is usually marked and does not respond to treatment readily. It is paroxysmal, and while it is severe it is unproductive. When it becomes productive, the sputum is mucoid and sometimes streaked with blood. Hemorrhage occurs late in the disease, and then the sputum sometimes looks like cranberry sauce or currant jelly.

With progress of the tumor and parenchymal infiltration, the cough changes, and there may be purulent sputum. The pain commonly is a dull ache but becomes severe as the tumor progresses and is not controlled by narcotics. Dyspnea usually develops later, and on auscultation one hears the characteristic respiratory wheeze, which is definite and localized to the point where the bronchus is obstructed.

No features of pulmonary carcinoma are really diagnostic. On physical examination the symptoms and signs vary according to the progress of the tumor. In the early stage in most cases the only symptom is cough. In the next stage, when the tumor begins to proliferate and cause obstruction, there is a respiratory wheezing. Later comes dyspnea and then hemorrhage. When infiltration into the parenchyma becomes marked and definite cavitation occurs, the sputum becomes purulent and bloody. When the carcinoma infiltrates other tissues and presses on the mediastinal organs there are symptoms resembling those produced by aneurysm or by any other kind of tumor in this region—such symptoms as dysphagia, aphonia, inequality of the pupils and distention of the veins of the chest and neck.

In the last stage, when marked infiltration is present, there is an effusion which is sometimes, but not always, blood-tinged. When the effusion is clear, differentiation from tuberculosis becomes more difficult. With progression of the tumor, the physical findings are altered. Dulness develops over the area of the tumor, and later flatness. Above the area of the tumor there are the physical signs of an emphysematous lung, while below the site of the tumor there are the physical signs of atelectasis, such as diminished voice sounds and decreased tactile fremitus,

with impairment of resonance. Sometimes these manifestations are altered because of a complicating bronchiectasis in the atelectatic area.

In the last stages, when metastasis becomes generalized, there is a varied symptom complex, and one may have to differentiate this condition from almost any disease. The principal condition from which carcinoma of the lung must be differentiated is tuberculosis. According to Lawrason Brown, the five cardinal criteria in the diagnosis of tuberculosis are râles in one or both apexes, infiltration as manifested by the roentgenogram, tubercle bacilli, pleurisy with effusion and hemorrhage. He states that the finding of any two of these signs reduces the possibility of error in diagnosis to about 2 per cent. It is more difficult to make a diagnosis when tuberculosis and carcinoma are associated. The most helpful diagnostic procedures are roentgen examination, bronchoscopy and, in case the tumor is in the pleural area, thoracoscopy; when the tumor is situated in the smaller alveoli and cannot be reached by the bronchoscope, roentgen examination may be assisted by the injection of iodized poppy-seed oil 40 per cent.

Pulmonary carcinoma commonly has an acute onset and must then be differentiated from pneumonia, bronchopneumonia, influenza and empyema. As it progresses, it must be differentiated from bronchial foreign bodies, atelectasis, bronchiectasis, and tumors of the lung of other types. When pressure symptoms occur, it must be differentiated from aneurysm, tuberculosis of the tracheobronchial glands, Hodgkin's disease of the mediastinal glands, lymphatic leukemia, lymphosarcoma, substernal thyroid, thymoma and carcinoma of the esophagus.

DR. HOLLIS E. POTTER: An introduction to the roentgenologic aspects of this subject was given by the speakers who exhibited lantern slides of several carcinomas of the lung in the later stages, which were exceedingly interesting in connection with the autopsy specimens. Having glimpsed these slides, I shall speak first of cases in which the tumor is in the late, complicated stage and then mention the findings in cases in which the growth is in the early stage.

The roentgen picture in the late stage of bronchiogenic carcinoma is by no means as distinctive as that in the early stage. The main reason for this is that the complications of bronchostenosis, atelectasis, infarction, exudate, bronchiectasis and pneumonia are so likely to be present. Under these conditions one or more borders of the cancer are overlapped by the complicating lesions, so that the tumor is obscured if not entirely eclipsed. Any one or a combination of these complications is likely to be present, however, when a diagnosis of carcinoma is first entertained in regard to a patient who has shown symptoms of simple pleurisy or of some other simple disturbance in the chest. Unfortunately, in the practice of many internists roentgen examination is not made until the condition presents some serious or puzzling aspect. I wish to emphasize how indeterminate the results of roentgen examination may be in advanced bronchiogenic carcinoma even in the hands of the most experienced observer.

It is true that the complicating lesion is likely to be located below the level of the tumor, only partly overshadowing it. One may then be able to recognize the presence of a more solid mass in the general region of the hilus and to suspect its malignant nature. By withdrawing pleural fluid one may often be aided in outlining the residual mass, but the adjacent lung is seldom rendered normal by simply withdrawing the fluid. When complicating lesions are not a prominent part of the picture, two or three roentgenologic observations made at intervals may serve to show the growth of the mass and aid in diagnosis.

Unfortunately, bronchiogenic carcinoma sometimes develops in an area which has long been the seat of fibro-ulcerative tuberculosis. It may be easy to recognize the general features of the tuberculosis but difficult or impossible to identify the carcinoma in a dense fibroid area.

In the earlier stages of the disease, before complications confuse the true picture, the presence of a solid tumor in the lung is rather easy to prove, and it is then more legitimate to analyze its physical characters in an attempt to determine its pathologic nature. It may be of variable size, form and texture, but its location is most likely to be in the vicinity of the largest bronchi. Frequently it is first

visible as a mass at the hilus, for the glands of the hilus tend to be invaded early by extension. A mass originating at this area which is found to extend into the surrounding tissue of the lung must be viewed with suspicion and watched for any further signs of lawless growth. The mass is usually not smooth and convex at the border like an aneurysm but more or less irregular whether finger-like extensions into the surrounding lung are present or not. Internally the mass presents no characteristic pattern. Its density is that of most soft tissue.

Bronchiogenic carcinoma must be differentiated from all other primary and secondary tumors of the lungs, the lymph glands and the mediastinum. Differentiation must also be made from fibroid tuberculosis, interlobar pleurisy and other regional inflammatory diseases. A tumor springing from the spine may also cause confusion but should be easily recognized in any complete roentgen study.

It was recently suggested at the Mayo Clinic that lymphoid tumor masses such as are often found at the hilus in Hodgkin's disease, leukemia, lymphoblastoma and similar conditions can be rather quickly differentiated from carcinoma by roentgen treatment, which causes a prompt reduction in the size of the lymphoid tumors but has less effect on carcinoma.

Without attempting to give detailed differential points between carcinoma and aneurysm, substernal goiter, dermoid, enchondroma, lymphoid infiltrations, tuberculous deposits and other conditions, I will say that by roentgen examination alone one usually arrives at an opinion, which is considerably less than a proved diagnosis unless after a reasonable time a repetition of the roentgen study shows progressive extension of the growth, metastases to other parts of the lung or complications characteristic of this type of malignant tumor.

DR. SAMUEL SALINGER: I can remember back in the dim, distant days that when one of the hapless progeny of the proletariat inadvertently swallowed a penny or a nickel he was rushed to the hospital (usually a charity hospital), where by the use of one of "those nice, new, shiny instruments" an attending laryngologist or his assistant dexterously extracted the coin (usually the only cash recompense for his trouble). On the following day, a newspaper article usually appeared, extolling the great skill of the surgeon and the marvelous new invention through which one could look into the deep cavity of the chest and whereby life could be saved. It was thought that something phenomenal had been achieved. I think that physicians have come a long way since those days in that they have for some time realized that they are more than mere safety pin extractors, food excavators or coin snatchers and that there is a much wider use for these shiny, lighted tubes.

Recently, at our hospital, my associates and I have seen several cases of cancer of the lung. One in particular impressed me for the reason that the patient was brought in with a diagnosis of carcinoma of the stomach and liver and sundry other abdominal organs. Examination of the chest at that time showed atelectasis of the upper lobe of the right lung, which with other physical findings led to the diagnosis of carcinomatous metastases to the lung. On bronchoscopic examination, however, we found a very small tumor that was occluding the bronchus of the upper lobe, and after histologic examination we made a diagnosis of squamous cell carcinoma. We claimed then that the order of development was the reverse of that originally conceived, namely, that the growth originated in the bronchus and metastasized to the abdominal organs. I think that most diagnosticians and pathologists would support this view.

I noticed that only one of the lantern slides that were shown depicted a lesion in the lung which was considered a metastasis from a carcinoma elsewhere I believe that in most cases in which there is carcinoma in the lung, especially epithelioma, with lesions in other organs, the lung is the primary site of the involvement. While endoscopic examination gives positive results in a smaller proportion of all cases than one would wish, a diagnosis based on these positive findings is definitely more scientific than a presumptive diagnosis.

If laryngologists had an opportunity to use their bright new instruments more often they might, in cases in which the lesion can be reached, be of much assistance

in making diagnoses early enough for surgical intervention. Certainly one has nothing to lose in recommending endoscopy in every case of intractable or unexplainable cough.

DR. HENRY C. SWEANY: In regard to Dr. Salinger's remarks about metastatic nodules in the lung, I should like to point out that the material that my associates and I presented does not represent pulmonary cancer in general. Most cancers primary elsewhere are eliminated before the patients are admitted to our institution, and I should not like to leave the impression that primary cancer of the lung is more frequent than the metastatic type. I also wish to emphasize that if a careful study is made as to the origin of the cancer most growths of the metastatic type can be recognized by observation of their gross appearance and by microscopic study. Moreover, primary cancer of the lung sometimes grows rapidly into the blood vessels and metastasizes early. That type cannot be benefited by treatment; it causes difficulty in diagnosis from the neurologic standpoint and leads to the complications that Dr. Potter mentioned, for which little or nothing can be done. There is a small group of cases, perhaps 25 per cent, in which the laryngologist has a rôle to play in progressive treatment, and I certainly believe that he should be consulted in any case in which there has been a chronic cough without sputum. In diagnosis his field is much larger.

Regarding the question of foreign bodies, it seems to me that a foreign body by itself would play a relatively slight rôle, no greater than that of any of the other irritants which I mentioned. As to the preponderance of involvement of the right lung over that of the left, the difference is not so great, the ratio being about 55:45, and is in proportion to the greater bronchial surface on the right side.

PATHOGENESIS AND END-RESULTS OF DURAL SINUS THROMBOSIS. DR. FRANCIS L. LEDERER.

A clinical and pathologic study has been made of latent thrombophlebitis in connection with mastoid disease and osteomyelitis of the skull in a new-born infant. The study also included a case of latent thrombosis of the cavernous sinus in association with osteomyelitis of the maxilla following purulent rhinitis in a new-born infant. The term "latent" is used to imply a concealed thrombosis, the thrombotic manifestations in both the cases being overshadowed by the osteomyelitic symptom complex.

In the first case, osteomyelitis of the skull developed following mastoiditis (Streptococcus mucosus-capsulatus type). The patient was observed over a period of eighteen months, at the end of which time death ensued, apparently not as the result of the pathologic process that was found. A thorough histologic survey post mortem disclosed obliterating thrombosis of the dural sinuses, including the superior longitudinal sinus. The physiology and symptomatology in connection with such a thrombosis have been reviewed and the observations in the present cases found to be quite different from the conceptions voiced in the literature. Study of the cases likewise indicates that the mechanism whereby the thrombosis becomes organized is associated with the type of healing which takes place in brain tissue.

The second case involved the study of serial sections through the head of a 3 week old infant in whom osteomyelitis of the maxilla developed following a purulent rhinitis, with formation of an abscess and a thrombus in the cavernous sinus. (Fulminating sinus disease and the various causative factors described in the literature are discussed.) A careful histologic dental examination failed to disclose the pathologic process originating in the deciduous teeth which has heretofore been held to be so prominent in the pathogenesis of this disease.

In summarizing, I may say: Spontaneous resolution is an inherent quality of the thrombotic process, and organization may occur. In a histologic study an unusual opportunity presented itself to demonstrate the mechanics of organization, as the abscess in the sinus was being encroached on by bundles of connective tissue fibers. Various stages of organization were easily demonstrated. A distinct feature was the presence of gitter cells in the healing of the thrombotic process (Hassin). These cells, usually found in the central nervous system and in the process of

scar formation there, apparently played an important rôle in the organization of the thrombus. The finding of a normal brain with no internal or external hydrocephalus is strikingly unusual in view of the existing theories regarding the absorption of spinal fluid by the longitudinal sinuses after it is filtered by the pacchionian bodies.

The latent thrombosis of the sinuses was secondary to the disease of the mastoid in one case and to that of the accessory sinuses in the other. The term "latent" indicates a concealed thrombosis not manifesting itself in the classic way and uncovered only in the course of a thorough histologic study. By some, the latency will be ascribed to the type of invader (Streptococcus mucosus-capsulatus in my first case). In such cases there is a latent period, and then a pathologic condition far out of line with the symptomatology is revealed. Osteomyelitis of the skull was present in both of my cases.

I have reviewed histologically the pathogenesis of osteomyelitis of the maxilla in infants, with all of the means of extension and the complications. It is evident from the literature that the portal of entry and the method of extension may be variable. Dogmatic statements have been made by proponents of each mode of invasion, but by a careful study of my case I find that every means of extension may be involved in the process. Evidence is presented to show that nasal infection and sinusitis may play an important rôle in the pathogenesis of such a process in young persons.

Very few of the cases recorded in the literature have had thorough histologic study, and it is difficult to determine the disease complex solely by clinical means. The patients are often observed after so long a lapse of time that the nature of the primary process can only be inferred. I feel that with the results of my studies in mind I am in a position to view many past experiences with a much clearer conception. In the case I have outlined, it is difficult to picture any therapy, whether conservative or radical, which would be applicable.

DISCUSSION

DR. GEORGE T. JORDAN: This article of Dr. Lederer's has impressed me by the conciseness and thoroughness of its preparation, the excellent review of the literature, from which valuable statistics have been deduced, the accurate clinical history of the cases cited and the postmortem pathologic and microscopic reports. In the case of so-called latent thrombosis following mastoid disease one is confronted with the time-honored problem of "to ligate or not to ligate." Deductions from the clinical manifestations or the postmortem observations would not cause any one to change his opinion, no matter which method of treatment he might favor. The fact that this patient was apparently not seriously ill and yet had thrombosis of the longitudinal and lateral sinuses in addition to the mastoid trouble makes one wonder how often similar conditions have been overlooked. Another thing worth remembering is the occurrence of osteomyelitis on the same side of the head.

In regard to the second case cited, that of osteomyelitis of the skull in association with disease of the accessory nasal sinuses, it is pointed out that sinus disease in infants and children is more common than was formerly believed. The patient in this case was only 3 weeks old.

After listening to this discourse, undoubtedly one will watch more closely for symptoms of sinus thrombosis and also for involvement of the accessory sinuses in infants.

One other thing that Dr. Lederer proved is that this disease does not always originate from the tooth buds.

DR. T. C. GALLOWAY: I am sorry that Dr. Lederer did not have time to mention the work of Wilensky, who I think has established osteomyelitis of the new-born as a clinical entity. I presented a case of this condition before the society last year. One of the discussers at that meeting said that all physicians have seen many such cases—that they are not uncommon. After further consideration I became more convinced that osteomyelitis of the new-born is a definite and rare clinical entity, not to be confused with ordinary sinusitis. Wilensky collected

reports of only about forty-three cases from the literature. I think that this diagnosis fits Dr. Lederer's case. Wilensky and others have shown that the internal maxillary artery in the new-born is for the first few weeks essentially an end artery and that if anything, notably embolism, affects this artery or its branches, there is mass destruction in the associated area. It is much more understandable that in this way occurred the massive destruction which Dr. Lederer's case presented, involving the entire maxilla and the surrounding bones, than that it all occurred by continuity from a single atrium of infection. The histologic slides were excellent but illustrated a terminal stage.

In my case I put through and through drains from the canine fossa to the orbital margin, put Penrose tubing through inside and outside the alveolar ridge and made a window in the wall of the antrum so that there would be complete drainage, and following the teaching of Dr. Potts I preserved all the periosteum possible as a scaffold. After about fifteen months, the child has a fairly well formed face. Some tooth buds have been extruded, and there will probably be some interference with dentition, although two teeth have come down in the proper places.

DR. SAMUEL SALINGER: The report was a little confusing because Dr. Lederer used the word "sinus" as applying both to the cranial venous sinuses and to the nasal accessory sinuses, but in the original paper I have no doubt the allusions are made clear.

Another angle of this situation, which was not mentioned, was brought out in an article by Riegele that I recently read. He showed that the process usually is most active in the ossification centers of the infantile maxilla, which determines the spread of the disease.

The latency of the symptoms of thrombosis can be attributed to the fact that the symptoms of osteomyelitis are so overwhelming that the typical septic manifestations of sinus thrombosis fail to develop. The case that I mentioned to Dr. Lederer was that of a boy, aged 14, in whom, without any cause that could be determined, swelling suddenly developed over the upper jaw, the alveoli and the upper part of the nose and fistulas appeared about the alveolar arch. The patient did not appear particularly ill, yet when I opened the antrum through a sublabial incision I found an erosion just below the orbit and the entire lining of the sinus exfoliated into the cavity. The boy had been sick only ten days. I do not know what the future will be; the sinus may go on draining and the patient recover, or the condition may develop into the type that Dr. Lederer has described.

DR. FRANCIS L. LEDERER: The necessity of hurrying through my paper because of the brief time allotted my presentation naturally brought about the omissions mentioned. As I said in introducing my subject, my survey of the literature could not be presented in such a short time, and while I no doubt have overlooked some studies I refer twice in my paper to Dr. Wilensky's excellent articles, and I am well acquainted with his views. He feels that osteomyelitis in infancy differs in no way from osteomyelitis in general. I do not dispute that; but, on the other hand, osteomyelitis is an end-result, and I prefer to discuss the factors which possibly lead to such a process. I hoped to prove that histologically the primary focus in my second case was in the inferior turbinate and that the spread of the disease combined all such possibilities as continuity of structure, thrombophlebitis, etc. I also wished to bring out the changes which occur as the result of such influences, not to draw conclusions from this study but rather to respect the possibilities which may exist. There can be no dogma, as other workers have tried to stress. This effort involves no *post hoc ergo propter hoc* reasoning but represents a study of over five hundred serial sections through the head of this infant. I think it is only by a study like this that one proves anything. Study of these sections definitely shows that there was an old organized process in the nose, older than any other shown in this entire series of sections. From the sections I was able to reconstruct a course of events that coincided chronologically with the clinical course. Wilensky mentions that this disease is more common in the first three weeks of life, but I think it is more common in the

first nine months. I do not think that one can limit the cases to nurslings alone. Then, too, one must ascertain that all those who have expressed opinions are discussing the same pathologic entity. Dr. Galloway would like to think of this disease as osteomyelitis of the maxilla per se, and that one can negate the work of others. Different clinicians consider the problem from different points of view, and their considerations seem to be borne out by their study. I feel that there is no doubt about the osteomyelitic process but that it is an end-result. About a year ago when this subject was discussed, Dr. Galloway mentioned that he had a similar case that he was going to study. I asked Dr. Poncher to get in touch with Dr. Galloway, thinking he might have some serial sections that we might compare, but his patient got well. Yet on the basis of such experience he is able to agree with Dr. Wilensky. All have had patients with osteomyelitis in severe form, even with sequestration, who were near death and yet recovered. I showed sections from three such cases in my slides this evening. The members will recall that I said that I refuse to draw conclusions from cases in which the patients get well. I am just as much in the dark as any one as to such cases, because I know neither the pathogenesis nor the nature of the pathologic changes. I can guess at them, but it is only by such a serial study as was made in the case which I just reported that one can really learn about such cases. The literature is full of case reports and theories, but studies similar to the one I have made are few and far between.

I am sorry that in my haste in presenting the paper I had to skim over much of my material and the literature and could not give credit to many men who have contributed to the subject. It is likely too that my list of references has suffered some omissions.

If histologic study cannot show the nature of the process in a case on which one might base some conclusions, I am at a loss to know what can. The sections that I showed were not sections of extruded bone but sections of the whole head.

Directory of Otolaryngologic Societies *

FOREIGN

Collegium Oto-Rhino-Laryngologicum Amicitiæ Sacrum

President: Prof. Gunnar Holmgren, Karolinska Mediko Kirurgiska Institut, Stockholm, Sweden.
Secretary: Prof. Dr. C. E. Benjamins, Verlengde Heereweg, 143, Groningen, The Netherlands.
Place: Stockholm, Sweden. Time: September 2-5, 1934.

NATIONAL

American Medical Association, Section on Laryngology, Otology and Rhinology

Chairman: Dr. W. P. Wherry, 107 S. 17th St., Omaha.
Secretary: Dr. John J. Shea, 1018 Madison Ave., Memphis, Tenn.
Place: Cleveland. Time: June 11-15, 1934.

American Academy of Ophthalmology and Oto-Laryngology

President: Dr. B. R. Shurley, 62 W. Adams Ave., Detroit.
President-Elect: Dr. J. M. Wheeler, 30 W. 59th St., New York.
Executive Secretary: Dr. William P. Wherry, 1500 Medical Arts Bldg., Omaha.
Place: Chicago. Time: Sept. 9-14, 1934.

American Bronchoscopic Society

President: Dr. W. F. Zinn, Medical Arts Bldg., Baltimore.
Secretary: Dr. Louis H. Clerf, 128 S. 10th St., Philadelphia.

American Laryngological Association

President: Dr. George M. Coates, 1721 Pine St., Philadelphia.
Secretary: Dr. W. V. Mullin, 9204 Euclid Ave., Cleveland.
Place: Cleveland. Time: June 7-9, 1934.

American Laryngological, Rhinological and Otological Society

President: Dr. J. W. Jervey, 101 Church St., Greenville, S. C.
Secretary: Dr. R. L. Loughran, Bridgewater, Conn.
Place: Charleston, S. C. Time: April 3-5, 1934.

SECTIONS:

Eastern.—Secretary: Dr. Vernon L. Bishop, Medical Arts Bldg., Rochester, N. Y.
Southern.—Secretary: Dr. Fletcher D. Woodward, P. O. Box, 1685, University, Va.
Middle.—Secretary: Dr. Frank J. Novak, Jr., 30 N. Michigan Ave., Chicago.
Mid-Western.—Secretary: Dr. Arthur W. Proetz, Beaumont Bldg., St. Louis.
Western.—Secretary: Dr. Ralph F. Davis, Mayer Bldg., Portland, Ore.

American Otological Society

President: Dr. John R. Page, 127 E. 62nd St., New York.
Secretary: Dr. Thomas J. Harris, 104 E. Fortieth St., New York.
Place: Atlantic City. Time: 1934.

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* Secretaries of societies are requested to furnish the information necessary to keep this list up to date.